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SPORT FISHERY ABSTRACTS

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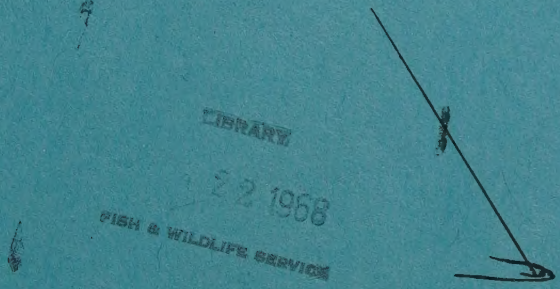

Vol. 13, No. 3, 1968

Abstracts 9962 - 10161

DEPARTMENT OF THE INTERIOR

U. S. FISH AND WILDLIFE SERVICE

BUREAU OF SPORT FISHERIES AND WILDLIFE

DEPARTMENT OF THE INTERIOR

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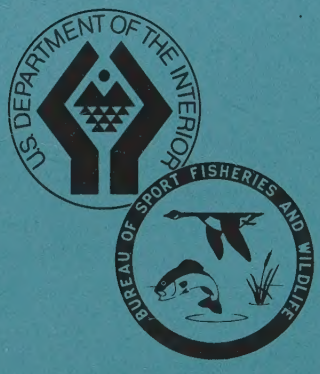

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Prepared in the Division of Fishery Research

Washington, D. C.

SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

Vol. 13, No. 3 Abstracts 9962-10161 1968

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

One volume consisting of four numbers is issued each year. Each number contains separate Author and Subject indexes. The final number of each volume contains cumulative Author and Subject indexes and a list of publications screened.

Suggestions for improving the usefulness and scope of Sport Fishery Abstracts are solicited.

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Editor, Sport Fishery Abstracts
Bureau of Sport Fisheries and Wildlife
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9962. Zubina, N. F. 1966. VARIATION WITH AGE OF BLOOD VOLUME AND HEMOGLOBIN LEVEL IN HATCHERY-REARED RAINBOW TROUT. (Vozrastnye izmeneniya ob'ema krovi i kolichestva gemoglobina u raduzhnoi foreli v usloviyakh iskusstvennogo razvedeniya). In: Report Summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 92-93. From: Ref. Zh., Biol., 1967, No. 21124. (Translation); Biological Abstracts, 48(19): Abst. No. 95075. 1967.

Hemoglobin concentration in the blood of rainbow trout increases during the first 2 years of life from 2.21 g percent in 30-day-old individuals to 8.81 and 11.13 g percent in 2-summer females and males. Erythrocyte count and blood volume change little.

9963. Szabolcs, M., A. Kover, L. Kovacs, and Maria Racz (Univ. Med. Sch., Debrecen, Hungary). 1966. SOME PROPERTIES OF THE SARCOPLASMATIC RETICULAR FRACTION OF FISH (Ameiurus nebulosus) MUSCLE [brown bullhead]. Acta Biochim. Biophys. Acad. Sci. Hung., 1(3): 233-244; Biological Abstracts, 48(19): Abst. No. 95422. 1967.

Adenosine triphosphatase (ATPase) and cholinesterase activities and Ca uptake in fractions obtained from fish muscle homogenizates by differential centrifugations at 1,000xg, 8,000xg, and 25,000xg, respectively, were studied. These enzyme activities and Ca uptake are characteristic for the 1,000xg to 8,000xg (Fr. II) and for the 8,000xg to 25,000xg (Fr. IV or SRF) fractions. These fractions behave similarly with respect to Ca^{++} uptake and ATPase activity in the presence of sodiumazide and dinitrophenol. During aging the Ca^{++} uptake of Fr. IV or SRF decreases with a simultaneous increase in ATPase and cholinesterase activities. The cholinesterase activity is high (60-90 μM acetylcholine/mg of protein/hr) and from the histochemical reaction on the cellulose column it seems probably that this is not due to adsorption. The ATPase activity of Fr. IV increases until a certain phase of aging (48 to 60 hrs.) both with and without oxalate in the presence of 0.12 mM Ca^{++} in the medium. Under the same experimental conditions the enzyme activity was inhibited from the third to fourth day onward. A certain difference was found in the Ca^{++} uptake of Fr. IV between rabbit and fish muscles, especially with respect to the effect of oxalate and Ca^{++} concentration. These findings suggest that the structure of the sarcoplasmatic reticulum of the 2 species is different. (Authors)

9964. Schwartz, Erich, and Arthur D. Hasler (Dept. Zool., Univ. Wisconsin, Madison, Wisc.). 1966. SUPERFICIAL LATERAL LINE SENSE ORGANS OF THE MUDMINNOWS (Umbra limi). Z. Vergleichende Physiol., 53(3): 317-327. (Ger. summ.); Biological Abstracts, 48(19): Abst. No. 95541. 1967.

Umbra limi has an elaborate development of superficial neuromasts on the head and body. The individual lateral line organs of the head form rows. Intermittent clusters of organs occur on the body. The "lateral line" consists of free standing organs, which are oriented alternating horizontally and vertically. A lateral line canal is wanting. The fish respond to water currents as small as 1.6 mm/sec. They also orient to fairly strong surface waves. (Auth)

9965. Ferguson, Denzel E., and C. Rex Bingham (Dept. Zoology, Mississippi State Univ., State College, Miss.). 1966. THE EFFECTS OF COMBINATIONS OF INSECTICIDES ON SUSCEPTIBLE AND RESISTANT MOSQUITOFISH (Gambusia affinis). Bull. Environ. Contam. Toxicol., 1(3): 97-103; Biological Abstracts, 48(19): Abst. No. 96235. 1967.

9966. Mathur, D. S. (Zool. Dept., Birla Coll. Pilani, Pilani, Rajasthan, India). 1965. HISTOPATHOLOGICAL CHANGES IN THE LIVER OF CERTAIN FISHES INDUCED BY DIELDRIN. Sci. Cult., 31(5): 258-259; Biological Abstracts, 48(19): Abst. No. 96242. 1967.

9967. Tat'yankin, Yu. V. (Murmansk Mar. Biol., Inst., Murmansk, USSR). 1966. UPPER TEMPERATURE THRESHOLD OF COD AND POLLACK FRY AND ITS DEPENDENCE ON THE ADAPTATION TEMPERATURE. (Verkhnii temperaturnyi porog u segoletok treski i saidy i ego zavisimost' ot temperatury adaptatsii). Dokl. Akad. Nauk. SSSR 167(5): 1159-1161. Illus.; Biological Abstracts, 48(19): Abst. No. 96317. 1967.

The heat resistance of the fry of cod (Gadus morhua morhua L.) and pollack (Pollachius virens (L.)) was investigated with respect to their different reaction to the effect of temperature. The temperature of the upper lethal boundary was taken at the index of resistance to high temperatures. The effect of a change of environmental temperature on the heat resistance of codfish was also studied. Experimental results indicated that the fry of pollack are more resistant to heat than cod fry adapted to the same temperature: the upper lethal temperature of the pollack fry was 25.1 degrees and of cod 22.9 degrees. A change of the environmental temperature affected the resistance of the fish to the effect of high temperatures. A very slight shift toward a drop of the upper lethal temperature for pollack was observed when they are held only for a day at a temperature of 1.4 degrees. In the fish which were adapted to low temperatures for a week, the upper lethal temperature dropped to 21.1 degrees for cod and to 19.2 degrees for pollack. The character of the change of the heat resistance of the fry of the 2 species with respect to changes of the environmental temperature was different. The difference of the upper lethal temperature for pollack adapted to a water temperature of 8-11 and 1-4 degrees was about 6 degrees and for cod it was of the order of 2 degrees. Thus, after holding for 7 days at a water temperature of 1-4 degrees the pollack became less heat resistant than the cod. --J. Slep.

9968. Shulyak, G.S. (Inst. Hydrobiol., Acad. Sci. Ukr. SSR, Kiev, USSR). 1965. EFFECT OF TEMPERATURE ON THE DEVELOPMENT OF ABNORMALITIES IN CARP INTESTINES. (Vliyanie temperatury na razvitie anomalii kishechnika karpa). Gidrobiol. Zh., 1(4): 39-47. Illus.; Biological Abstracts, 48(19): Abst. No. 96324. 1967.

A study of the effect of temperature on development of the digestive organs of carp fry showed a definite dependence between the effect of temperature and disturbance in the structure of the intestine. Not only the magnitude of the temperature, but its change in the course of the embryonic and postembryonic periods, is of significance, the most favorable conditions for the development of the intestine being a decrease in temperature during the embryonic period followed by a rise during the postembryonic period. A definite correlation was also found between the nature of the abnormalities, the growth of the fish and the temperature at which development occurred. (Auth.)

9969. Smirnova, G.P. 1966. THE EFFECT OF FOOD QUALITY ON THE THERMOSTABILITY OF Xiphophorus helleri. (Zavisimost' teploustoichivosti Xiphophorus helleri ot kolichestva potreblyaemogo korma). In: Report summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 114-115. From: Ref. Zh., Biol., 1967, No. 2I135. (Translation); Biological Abstracts, 48(19): Abst. No. 96325. 1967.

The thermostability of X. helleri was determined from the survival time at the lethal temperature of 37 degrees C. Resistance to high temperatures increased with increase in the time interval following feeding, and decreased with increase in the amount of food consumed by the fish.

9970. Kimura, Ikuo, Taketoshi Sugiyama, and Yohei Ito (Lab. Viral Oncol., Aich Cancer Center, Nagoya, Japan). 1967. PAPILLOMATOUS GROWTH IN SOLE FROM WAKASA BAY AREA. Proc. Soc. Exp. Biol. Med., 125(1): 175-177. Illus.; Biological Abstracts, 48(19): Abst. No. 96416. 1967.

A preliminary survey for tumor-bearing fish among sole caught in waters of Wakasa Bay area, Japan was carried out. Five sole, 1 Limanda herzensteini and 4 Hippoglossoides dubius, with skin tumors were obtained. Histological observations of the lesions in both species revealed marked proliferation of epithelial

elements accompanied with increase in fibrous structure of connective tissue. In addition marked increase of melanin-containing cells was observed in tissue sections of growth of L. herzensteini with darker appearance. The gross and microscopic findings of H. dubius resembled descriptions of the epithelial papillomas reported by other authors to occur among flathead sole populations near Friday Harbor, Washington. (Authors)

9971. Maxfield, Galen H. (Bur. of Commercial Fisheries Biological Laboratory, Seattle, Wash.). 1967. PACIFIC SALMON LITERATURE COMPILATION—1900-59. U. S. Department of Commerce, Clearinghouse for Federal Scientific and Technical Information, Doc. PB 174 102; 645 microfiches (42,341 p.) $185. Address: Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

Expanding research on the Pacific salmon (Oncorhynchus spp.) with resultant increase in publications has created literature problems for the fishery scientist. The purpose of the compilation, totaling 645 microfiches, is to make published scientific information on the five North American species of Pacific salmon immediately accessible and usable. The compilation contains 1,406 articles on original research comprising 17,895 pages of text from 119 serials, journals, and reports published during the 60-year period, 1900-59. The text material was analyzed and items of information were coded by 4,000 subject categories. The pages of text are duplicated as many times as different items of information under these subject categories are contained in the text. With these duplications the material totals 42,341 pages. Each item is arranged by author and date of publication. Instructions for use are given in the introductory text. (Auth.)

9972. Muntyan, S. P., and P. N. Reznichenko. 1966. EFFECT OF CONSTANT INCUBATION TEMPERATURES ON THE SURVIVAL OF PIKE-PERCH EGGS. (Vliyanie postoyannykh temperatur inkubatsii na vyzhivanie ikry sudaka). In: Report summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 87. From: Ref. Zh., Biol., 1967, No. 21120. (Translation); Biological Abstracts, 48(19): Abst. No. 96660. 1967.

The development of pike-perch eggs was investigated at constant temperatures within a range of 5 to 26.5° C. The optimal temperature was 11.5-14° C. The lethal temperatures were 5 and 26.5° C, which corresponds to the temperature range on the spawning grounds.

9973. De Villiers, J. P., and M. M. Rossouw (Nat. Chem. Res. Lab., Counc. Sci. and Ind. Res., Pretoria, S. Afr.). 1967. STRUCTURE AND ACTIVITY IN MOLLUSCICIDES. Nature, 213(5082): 1208-1209. Illus.; Biological Abstracts, 48(19): Abst. No. 97473. 1967.

From limited trials conducted with Tilapia mossambica, the amide molluscicides are toxic to fish. They have, however, extremely low oral toxicity to rats, as a dose of 2 g/kg body weight elicited no reaction. Pelargonyl morpholide is an irritant oil, but the compounds with molluscicidal activity have no irritant properties at all. The amide molluscicides are not the most effective molluscicides available when judged on a basis of their LC_{50} values. Because the effect of these molluscicides is a linear function of time and concentration, however, where prolonged dosing is possible very low concentrations can be used. The low cost and negligible mammalian toxicity of these molluscicides, coupled with their ease of manufacture and handling, undoubtedly make them attractive for further investigation on a large scale. (From auth.)

9974. Boeseman, M. (Rijksmus. Natuur. Hist., Leiden, Netherlands). 1964. THE FRESH-WATER FISHES OF THE ISLAND OF TRINIDAD: ADDENDA, ERRATA, ET CORRIGENDA. Natuurwetensch Studiekring Suriname Ned Antillen Uitgaven, 52-57. Illus.; Biological Abstracts, 48(19): Abst. No. 98952. 1967.

This paper provides new distributional data and includes 2 spp. not listed in the author's previous review of the fresh-water fishes of Trinidad. The systematic list includes notes on 10 spp., and adds Leporinus friderici (Bloch) and Gobionellus claytonii (Meek) to the Trinidad fresh-water ichthyofauna. --R. Sutcliffe.

9975. Cairns, John, Jr., and Arthur Scheier (Zoology Dept., Univ. of Kansas, Lawrence, Kansas). 1968. A COMPARISON OF THE TOXICITY OF SOME COMMON INDUSTRIAL WASTE COMPONENTS TESTED INDIVIDUALLY AND COMBINED. Progressive Fish-Culturist, 30(1): 3-8.

The toxicities of acetaldehyde, acetic acid, acetone, potassium cyanide, potassium dichromate, copper, naphthenic acids, and zinc chloride to the bluegill (Lepomis macrochirus) were assayed in soft synthetic dilution water both individually and in 4 combinations of 2 or more of these compounds. A temperature of 18° ± 2° C and a dissolved oxygen concentration of 5 to 9 ppm were maintained throughout the 96-hour test period. Comparisons of the concentrations resulting in 96-hour TL_ms (50% survival) indicated that a mixture of compounds became toxic when one of the components was at or near a concentration which would have produced a TL_m had it been alone. Where no synergistic interaction of waste components occurs, wastes may often be more effectively and economically treated if the more toxic components are segregated for intensive treatment before disposal or compositing with other wastes. (Authors)

9976. Groutage, Thomas M. (Illinois Dept. of Conservation, Macomb, Ill.). 1968. UNIQUE ILLINOIS POND SUPPORTS RAINBOW TROUT. Progressive Fish-Culturist, 30(1): 9-12.

Rainbow trout, Salmo gairdneri, have thrived for over 2 years in a 1-acre spring-fed pond in west-central Illinois. This period of survival is unusual, as most Illinois ponds are too warm or lack sufficient dissolved oxygen to support trout. Water temperatures in the pond ranged from 39° to 63° F, and dissolved oxygen from 8.8 to 18.4 ppm. The average total length of trout was 13.7 inches at age 1+, 14.5 inches at age 2, and 16.9 inches at age 2+. Spawning was observed, but no fry were seen. (Auth.)

9977. Latapie, Walter R., Jr. (Louisiana Wild Life and Fisheries Commission, New Orleans, La.). 1968. TAGS NOT RECOVERED FROM ATLANTIC CROAKERS. Progressive Fish-Culturist, 30(1): 12.

Five types of tags were tried on 42 Atlantic croakers (Micropogon undulatus). Of 22 croakers recovered 5 months later, only 1 fish had retained any part of a tag. This fish still had the hard plastic barb of a dart tag, but had lost the yellow spaghetti tubing with the identifying number.

9978. Flick, William (Dept. of Conservation, Cornell Univ., Ithaca, New York.). 1968. DISPERSAL OF AERATED WATER AS RELATED TO PREVENTION OF WINTERKILL. Progressive Fish-Culturist, 30(1): 13-18.

Spraying oxygen-deficient water on the ice increased oxygen in the upper few feet of water from 2.4 to 11.4 ppm. The success of aeration was dependent on water trickling through a large number of holes cut in the ice so that turbulence was minimal as compared with conditions set up by a large volume of water entering at a given point. Rhodamine-B dye, used as a tracer, indicated that aerated water fanned out in a shallow layer beneath the ice with little mixing below 4 feet. (Auth.)

9979. Bullock, Graham L. (Bur. Sport Fisheries and Wildlife, Kearneysville, W.Va.). 1968. THE BACTERIOLOGY OF BROOK TROUT WITH TAIL ROT. Progressive Fish-Culturist, 30(1): 19-22.

Examination of 25 yearling brook trout (Salvelinus fontinalis) showing varying severity of tail rot indicated that myxobacteria or other bacteria are not the primary cause of tail rot. It is suggested that bacterial involvement occurs after a lesion results from the presence of another disease, nutritional imbalance, injury, or other predisposing factors. (Auth.)

9980. Gunstrom, Gary K. (College of Fisheries, Univ. of Washington, Seattle, Wash.). 1968. GONAD WEIGHT/BODY WEIGHT RATIO OF MATURE CHINOOK SALMON MALES AS A MEASURE OF GONAD SIZE. Progressive Fish-Culturist, 30(1): 23-25.

Gonad size, expressed as percentage of total body weight, was determined for male chinook salmon (Oncorhynchus tshawytscha) returning to the ponds at the College of Fisheries, University of Washington, in the fall of 1966. An average of 6.73% of the total body weight was represented by the gonads of 157 males of 3 age groups, for a gonad weight:body weight ratio of 1:14.87. A 2% decrease in the representative weight of the gonads with each additional year of life was observed, the testes forming 9.62% of the body weight in 2-year-old males, 7.47% in 3-year-olds, and 5.65% in 4-year-old males. It is suggested that gonad weight: body weight ratio data, if compiled every year, may be used in the future as an index of growth or for comparison of populations of the same species. (Auth.)

9981. Herting, Gerald E., and Arthur Witt, Jr. (Peace Corps, Mayaquez, Puerto Rico). 1968. RATE OF DIGESTION OF THE BOWFIN. Progressive Fish-Culturist, 30(1): 26-28.

Young-of-the-year bowfin (Amia calva) were force-fed known weights of Gambusia affinis in the amount of 4.9% of their body weight and sacrificed at intervals. In 2 hours digestion had started in the posterior region of the stomach, at 12 hours 25% of the meal was digested, and at 28-32 hours digestion was complete. The rate of digestion was slower in bowfin than in longnose gar and slower in these fishes than in certain members of the Teleostei. (Authors)

9982. McComish, Thomas S. (Missouri Cooperative Fishery Unit, Univ. of Missouri, Columbia, Mo.). 1968. SEXUAL DIFFERENTIATION OF BLUEGILLS BY THE UROGENITAL OPENING. Progressive Fish-Culturist, 30(1): 28.

Sexual differentiation in the bluegill (Lepomis macrochirus) at the onset or after sexual maturity can be readily determined by the appearance of the urogenital opening. Tested during all seasons of the year on fish from central Missouri, this method of sexing has proved to be entirely satisfactory. (Auth.)

9983. Lewis, William M. (Fishery Research Lab., and Department of Zoology, Southern Illinois Univ., Carbondale, Ill.). 1968. ISOBORNYL THIOCYANOACETATE AS A FISH DRUGGING AGENT AND SELECTIVE TOXIN. Progressive Fish-Culturist, 30(1): 29-31.

Isobornyl thiocyanoacetate in the form of the insecticide Thanite emulsified with 20% kerosene and 10% Atlox (a commercial emulsifier) was demonstrated to be an effective fish toxin. The golden shiner, channel catfish, and black bullhead tolerated a concentration approximately three times greater than that tolerated by the bluegill and green sunfish. Thus selective kill of these centrarchids in the presence of certain other species is feasible. Live recovery of bass was demonstrated to be feasible. (Auth.)

9984. Busbee, Raymond L. (Cooperative Sport Fishery Unit, Univ. of Georgia, Athens, Ga.). 1968. PISCIVOROUS ACTIVITIES OF THE CHANNEL CATFISH. Progressive Fish-Culturist, 30(1): 32-34.

Three hundred and fifty-four channel catfish (Ictalurus punctatus) stomachs were analyzed to determine at what point in its life cycle this fish becomes a piscivorous feeder. The study specimens ranged in total length from 8 to 24 inches. Seventy-six stomachs were empty. Fifty-six stomachs contained identifiable fish, fish bones, or fish scales. No channel catfish less than 11 inches in length was observed to have been using fish as part of its diet. A noticeable increase in the quantity of fish found in catfish stomachs was first detected in the 14- and 15-inch size class. (Auth.)

9985. Garrison, Robert L. (Oregon State Game Commission, Corvallis, Oreg.). 1968. THE TOXICITY OF PRO-NOXFISH TO SALMONID EGGS AND FRY. Progressive Fish-Culturist, 30(1): 35-38.

The toxicity of Pro-Noxfish was tested on 100-day-old fall chinook (Oncorhynchus tshawytscha) fry and eyed coho (O. kisutch) eggs in the laboratory and on eyed chinook eggs in the field. Coho eggs were more tolerant of Pro-Noxfish than chinook fry. The toxicity of Pro-Noxfish to coho eggs was affected by the temperature, concentration, and length of exposure. (Auth.)

9986. Broach, Dick (Arkansas Game and Fish Comm., Little Rock, Ark.). 1968. A SMALL-CAPACITY SPILLWAY MODIFIED TO PREVENT REENTRY OF UNDESIRABLE FISHES. Progressive Fish-Culturist, 30(1): 38.

The structure shown is designed to provide isolation in lieu of a 6-foot vertical spillway drop where migration of rough fish over the low spillway is a problem.

9987. Clady, Michael D., and Gerald U. Ulrikson (Inst. for Fisheries Research, Michigan Dept. of Conservation, Ann Arbor, Mich.). 1968. MORTALITY OF RECENTLY HATCHED BLUEGILL FRY AS A RESULT OF HYDRA. Progressive Fish-Culturist, 30(1): 39-40.

The hydra (Hydra carnea) population in an outdoor rearing facility for young bluegills (Lepomis macrochirus) reached a high level in July after a dense bloom of zooplankton. Complete mortalities of 2 broods of newly hatched bluegill fry were apparently due to the migration of large numbers of hydra onto the nests soon after the fry emerged. Hydra killed and ate bluegill fry in the laboratory. It is suggested that the migration of hydra onto active bluegill nests was in response to microcurrents or chemical stimuli produced by the fry or hatching eggs. (Authors)

9988. Reingold, Melvin (Idaho Fish and Game Dept., Salmon, Idaho). 1968. WATER TEMPERATURE AFFECTS THE RIPENING OF ADULT FALL CHINOOK SALMON AND STEELHEAD. Progressive Fish-Culturist, 30(1): 41-42.

Attempts to hold and artificially spawn fall chinook salmon (Oncorhynchus tshawytscha) and fall-arriving summer steelhead trout (Salmo gairdneri) in water colder than their home stream resulted in losses up to 100%. (Auth.)

9989. Regier, H.A., and W.H. Swallow (New York Cooperative Fishery Unit, Cornell Univ., Ithaca, N.Y.). 1968. AN AQUARIUM TEMPERATURE CONTROL SYSTEM FOR FIELD STATIONS. Progressive Fish-Culturist, 30(1): 43-46.

A flexible, rugged, semi-automatic temperature control system for a group of aquaria is described. With proper insulation and juxtaposition of various components in an aquarium, the system maintains water temperatures within about 0.5° C of program set-point within the range of 10° to 35° C in room temperatures between 20° and 30° C. System components are relatively inexpensive as compared to self-contained temperature control units available from laboratory suppliers. (Authors)

9990. Ihm, William J. (Nebraska Game and Parks Comm., Lincoln, Nebr.). 1968. MOUNTING FISH SPINE SECTIONS RAPIDLY AND PERMANENTLY. Progressive Fish-Culturist, 30(1): 46.

Spine sections taken for age analysis are attached to plexiglas strips with vinyl cement, and collection data are inscribed on the plexiglas. The plexiglas slides have a hole drilled at one end and are easily stored. (Auth.)

9991. Lonsdale, E.M., and G.T. Baxter (College of Engineering, Univ. of Wyoming, Laramie, Wyo.). 1968. DESIGN AND FIELD TESTS OF A RADIO-WAVE TRANSMITTER FOR FISH TAGGING. Progressive Fish-Culturist, 30(1): 47-52.

A new type of electronic tag for specialized applications in fish tracking has been developed. This device uses electromagnetic energy (radio waves) rather than sonar signals. Ranges to 100 feet and life-times of a month are realized from a model costing less than $10. The tag described functions best in shallow water of low electrical conductivity. (Authors)

9992. Maxwell, James I. (Bur. of Sport Fisheries and Wildlife, Marion, Ala.). 1968. PRODUCTION OF CHANNEL CATFISH FINGERLINGS. Progressive Fish-Culturist, 30(1): 52.

A summary of the production of channel catfish (Ictalurus punctatus) fingerlings in 3 ponds at the Marion National Fish Hatchery in 1966, including pounds per acre, food conversion, problems encountered, and use of automatic feeders.

9993. Tracy, Harry B. (Research Div., Dept. of Fisheries, Vancouver, Wash.). 1968. DEVELOPMENT OF A SHALLOW-WATER TAGGING GUN. Progressive Fish-Culturist, 30(1): 53-56.

A tagging gun has been designed to tag adult chinook salmon without removing them from the water. The tagging gun, a modified Daisy Air Rifle, injects a Floy Company FT-1 or FT-2 dart tag a maximum of 2-1/4 inches into the fish. (Auth.)

9994. Griswold, Bernard L., and Robert S. Rupp (Maine Dept. of Inland Fisheries and Game, Orono, Me.). 1968. A TUBE FOR OBSERVING SALMONID EGGS IN NATURAL REDDS. Progressive Fish-Culturist, 30(1): 56.

The tube described here is used to observe salmonid eggs buried in spawning gravels at any time during the incubation period. Substrate water samples from around the eggs can be taken for chemical analyses, and an index of substrate water flow can also be obtained. (Authors)

9995. Fast, Arlo W. (California Dept. of Fish and Game, Lakeside, Calif.). 1968. A DRAG DREDGE. Progressive Fish-Culturist, 30(1): 57-61.

A zoobenthos sampler developed for sampling in the swift, turbulent water of the Colorado River below Davis Dam is described. Comparison with the Peterson dredge indicates that the drag dredge is an efficient qualitative benthic sampler. Of 6 benthic organisms analyzed, only 1 showed a significantly different sample distribution. Principal advantages of the drag dredge are its ease in handling, "in situ" sorting of samples, and rapidity in use. (Auth.)

9996. Burggraff, Leo J., and William C. Weiler (Dept. of Game, Fish and Parks, Denver, Colo.). 1968. A NEW FISH LOADER FOR COLORADO. Progressive Fish-Culturist, 30(1): 61.

The loader described here is designed to reduce manpower requirements, loading time, and injuries from wet, slick walkways around trucks and raceways. With this loader, 3 men can put 1,000 pounds of trout on a truck in 7 minutes—a job that formerly took 6 men 30 minutes. (Authors)

9997. Wydoski, Richard S., and David R. Wolfert (Bur. of Commercial Fisheries, Sandusky, Ohio). 1968. AN IMPROVED GIRTHOMETER FOR STUDIES OF GILL NET SELECTIVITY. Progressive Fish-Culturist, 30(1): 62-64.

The girthometer described here offers several improvements, including (1) modifications of the nylon loop that increases speed and accuracy of measurement; (2) a slide mechanism that is not affected by slime, does not jam, and is easily cleaned; and (3) a horizontal rule to measure fish length. This device will measure fish as long as 81 cm, with a girth as great as 48 cm.

9998. McCauley, R. W., and F. Trimborn (Waterloo Lutheran Univ., Waterloo, Ontario, Canada). 1968. INCUBATING RAINBOW TROUT EGGS IN HEATED, RECIRCULATED WATER. Progressive Fish-Culturist, 30(1): 64.

A 300-watt aquarium heater, set in the middle of a 26-gallon-capacity trough with 20,000 rainbow trout eggs on a series of trays, kept the temperature some 10° F above that of the water supply; a pump recirculated the water at a rate of 1.7 gallons a minute. Dissolved oxygen level was near 100% throughout the experiment. The ammonia concentration reached 5 ppm by the 14th day, but thereafter was held at 1 ppm by introducing unheated spring water (2 gallons an hour), a second heater, and activated charcoal.

9999. Combs, Bobby D. (Bur. of Sport Fisheries and Wildlife, Salmon-Cultural Lab., Longview, Wash.). 1968. AN ELECTRICAL GRID FOR CONTROLLING TREMATODE CERCARIAE IN HATCHERY WATER SUPPLIES. Progressive Fish-Culturist, 30(2): 67-75.

A parallel-plate-type, electrically charged grid killed over 90% of the Nanophyetus salmincola cercariae in a hatchery water supply. The most economical values of voltage gradient and exposure time, in terms of power consumption and cercaria kill, were 310 volts per inch and 0.325 second. (Auth.)

10000. Becker, C. Dale, and Wayne D. Brunson (Fisheries Research Institute, Univ. of Washington, Seattle, Wash.). 1968. THE BASS TAPEWORM: A PROBLEM IN NORTHWEST TROUT MANAGEMENT. Progressive Fish-Culturist, 30(2): 76-83.

Infections of larval cestodes, Proteocephalus ambloplitis (Leidy, 1887), in yearling rainbow trout (Salmo gairdneri) and other salmonids from two western Washington lakes are reported. In Washington State the bass tapeworm apparently infects salmonids only in environments shared with largemouth bass (Micropterus salmoides), an essential definitive host of the cestode. Infection of trout occurs during the summer in correlation with warm water temperatures (60° - 67° F) and the reproduction of adult cestodes in bass. Young cutthroat (Salmo clarki) and brook trout (Salvelinus fontinalis) also readily acquire the parasites, but lacustrine coho salmon (Oncorhynchus kisutch) appear relatively resistant. Elimination of the bass tapeworm from lakes of the Pacific Northwest through modification of routine rehabilitation and stocking procedures is discussed. Only uninfected bass should be planted in lakes intended primarily for trout production. (Authors)

10001. McElwain, Ivan B., and George Post (Bur. of Sport Fisheries and Wildlife, Mescalero, N.M.). 1968. EFFICACY OF CYZINE FOR TROUT HEXAMITIASIS. Progressive Fish-Culturist, 30(2): 84-91.

Cyzine (2-acetylamino-5-nitrothiazole) was tested for efficacy in the control of hexamitiasis of rainbow trout (Salmo gairdneri). A laboratory study was made to determine the in vitro efficacy of Cyzine for eliminating Hexamita salmonis from prepared culture media. The flagellate was effectively controlled by drug concentrations as low as 0.08 ppm. Rainbow trout were infected by anal inoculations of cultured H. salmonis. The effective in vitro Cyzine concentration was used to establish experimental levels of the drug in dry trout food that would eliminate the infection. Evidence indicated that concentrations as low as 10 ppm in dry trout food, given on a free choice basis for 3 days, were necessary to eliminate all organisms. Rainbow trout with naturally acquired infections of H. salmonis were given Cyzine in dry trout food. A 10-ppm concentration showed effective control of the disease, but a few fish harbored parasites after 3-day treatments. Concentrations of 20 ppm eliminated the infection in 3 days in all fish. A test of palatibility of high levels in dry pelleted fish food indicated that rainbow trout accept food containing as much as 10,000 ppm Cyzine. (Authors)

10002. Gunning, Gerald E., and Tim M. Berra (Tulane Univ., New Orleans, La.). 1968. REPOPULATION OF A DECIMATED STREAM SEGMENT BY THE SHARPFIN CHUBSUCKER. Progressive Fish-Culturist, 30(2): 92-95.

The sharpfin chubsucker (Erimyzon tenuis) population in a portion of Talisheek Creek, Louisiana, was decimated experimentally with a 230-volt electrical shocker. By the end of 1 year, sharpfin chubsuckers had moved into the decimated area in numbers greater than had been present before decimation. Though sharpfin chubsuckers are known to make spawning runs from rivers to tributary streams during the spring, movements of the suckers in this study indicated a type of movement not associated with spawning. Only 4 of the 26 sharpfin chubsuckers that repopulated the decimated stream segment had reached spawning size; hence repopulation of this section was accomplished principally by sexually immature fish. Other stream fishes apparently require much more time to repopulate at levels existing before decimation. (Authors)

10003. Konar, S.K. (Univ. of Bihar, Muzaffarpur, India). 1968. EXPERIMENTAL USE OF CHLORDANE IN FISHERY MANAGEMENT. Progressive Fish-Culturist, 30(2): 96-99.

Laboratory tests at 66° to 75° F revealed that LD_{50}s, and LD_{100}s of chlordane ranged from 0.00004 to 0.01 ppm, 0.0000709 to 0.0457 ppm, and 0.0001 to 0.08 ppm for nine fish species, and from 0.0004 to 0.1 ppm, 0.000790 to 0.1819 ppm and 0.0013 to 0.315 ppm for nine insect species. Phytoplankters were susceptible to 0.001 ppm, and most zooplankters died at 0.10 ppm of the insecticide. At 0.5 ppm, chlordane showed no reduction in residual toxicity in 100 days. (Auth.)

10004. Flick, William A. (Cornell Univ., Ithaca, N.Y.). 1968. EFFECTIVENESS OF THREE TYPES OF BARRIER PANELS IN PREVENTING UPSTREAM MIGRATION OF FISH. Progressive Fish-Culturist, 30(2): 100-103.

Indirect evidence indicated that barrier racks used on low dams in New York State might not be fishproof under certain water conditions. To test this hypothesis, fish traps were installed in conjunction with 3 types of barrier panels on a low dam. Thirty-two common shiners (Notropis cornutus) and several other species of fish were taken in the trap above the conventional type of barrier during the 6-week study. Only 1 of 3 panels tested was fishproof when a pool of water was present below the barrier. (Auth.)

10005. Saunders, Richard L. (Fisheries Research Board of Canada Biological Station, St. Andrews, New Brunswick, Canada). 1968. AN EVALUATION OF TWO METHODS OF ATTACHING TAGS TO ATLANTIC SALMON SMOLTS. Progressive Fish-Culturist, 30(2): 104-109.

Two tags for Atlantic salmon (Salmo salar) smolts and methods of attachment are described, with results of field tests of their effectiveness. A Swedish-type smolt tag which is attached with soft annealed stainless steel wire has 3 basic parts: label, growth sector, and anchor. A modification of this has plastic filament (polyethylene or surgical suture material) in place of the wire for the growth sector and anchor. Smolts carrying polyethylene or suture tags suffered less chafing damage than those with steel tags, but the latter gave consistently higher rates of adult recapture than either plastic attachment. There was no significant difference in recapture rates of salmon with polyethylene and surgical suture material. (Auth.)

10006. Morris, Larry A., and Paul F. Novak (Nebraska Game and Parks Comm., Lincoln, Nebr.). 1968. THE TELEPHONE GENERATOR AS AN ELECTROFISHING TOOL. Progressive Fish-Culturist, 30(2): 110-112.

A telephone generator driven by a small motor was an efficient fishery tool. In the Missouri River this device stunned both flathead and blue catfish. Channel catfish and black bullheads were also sensitive to the electric current, as they swam rapidly from the vicinity of the electrodes. The electrical parameters of this motor-driven telephone generator were smaller than conventional electrofishing devices. The a.c. voltage and current varied directly with the number of magnets used on the generator; an average output of 52.0 v and 169.0 ma could be obtained with all 5 magnets in place. The flathead catfish, however, was most susceptible to capture when only 2 or 3 magnets were used. This configuration produced between 24 v and 38 v and from 95 ma to 125 ma when tested in the laboratory. (Authors)

10007. Pozar, Dusan F. (Fisheries Research Board of Canada Biological Station, Nanaimo, British Columbia, Canada). 1968. AN AUTOMATIC WET-FOOD DISPENSER. Progressive Fish-Culturist, 30(2): 113-115.

The device described and illustrated automatically and continuously distributes a variety of wet foods to one or a number of holding tanks with fish or other aquatic animals. (Authors)

10008. Colby, Peter J., and Lloyd L. Smith, Jr. (Univ. of Minnesota, St. Paul, Minn.). 1968. A MICROSTRATA WATER SAMPLER FOR STREAM STUDY. Progressive Fish-Culturist, 30(2): 116-117.

This sampler was developed to take simultaneous samples of stream water at intervals of 1 to 20 mm above the substrate. Eight samples in this zone can be taken simultaneously. Results of successive samplings have had a high degree of consistency. (Authors)

10009. Dahlberg, Michael L., and Duane E. Phinney (Fisheries Research Inst., Univ. of Washington, Seattle, Wash.). 1968. A MICROPROJECTOR FOR USE IN SCALE STUDIES. Progressive Fish-Culturist, 30(2): 118-119.

The microprojector described--involving an illuminator, light guide, microscope, projection prism and mirror, and viewing surface, all housed in a plywood

box--was portable, cost lest than $300, and was satisfactory for the age analysis of 50,000 adult sockeye salmon (Oncorhynchus nerka) scales.

10010. Sumner, F.H. (Oregon State Game Comm., Corvallis, Oreg.). 1968. A METHOD FOR SCALE COMPARISON. Progressive Fish-Culturist, 30(2): 91

A method for side-by-side fish-scale comparison is presented. Scale circuli are traced by laying a piece of folded paper along the selected axis of the projected scale image and making a short mark opposite each circulus. About 20 "tracings" per sheet can be made. Distances on tracings from focus to checks and margin are measured, and lengths back-calculated. (Auth.)

10011. Bull, C.J. (Dept. of Recreation and Conservation, Victoria, British Columbia, Canada). 1968. A BOTTOM FAUNA SAMPLER FOR USE IN STONY STREAMS. Progressive Fish-Culturist, 30(2): 119.

The collapsible sampler described overcomes the principal difficulties usually encountered when a known area of removable substratum is provided for colonization by aquatic organisms. (Auth.)

10012. Toney, Don, and J.T. Bowen (Bur. of Sport Fisheries and Wildlife, Manchester, Iowa). 1968. SELECTION OF RAINBOW TROUT BROOD STOCK. Progressive Fish-Culturist, 30(2): 120.

As part of the selective breeding program for rainbow trout (Salmo gairdneri) at the Manchester National Fish Hatchery, Iowa, eggs of selected individuals were fertilized. The resulting fish were 22% heavier than the fish hatched from production lots of eggs.

10013. Schaefer, Richard H. 1968. SIZE, AGE COMPOSITION AND MIGRATION OF STRIPED BASS FROM THE SURF WATERS OF LONG ISLAND. New York Fish and Game Jour., 15(1): 1-51.

Between June of 1961 and November of 1964, a total of 4,924 striped bass were netted from the ocean surf at Great South Beach (N.Y.) using a commercial haul seine. All specimens were measured and the ages of many were determined. Of these, 912 collected between June of 1961 and November of 1963 were tagged and released, more than half of which were of large size, i.e., 600 millimeters or more in fork length or 6 pounds or more in weight. In addition, 178 striped bass ranging from 300 to 600 millimeters in fork length, were tagged and released at Westhampton Beach (N.Y.) between November of 1954 and May of 1956. Length-frequency and age-frequency data for the tagged fish are given, and data for tag returns are presented and discussed in relation to the time and place of release, fish size, and the season, location and method of recapture. The results suggest that a substantial proportion of the striped bass tagged at Westhampton Beach may have been of Hudson River origin, while those tagged at Great South Beach, which mostly represented the 1958 and 1961 year classes, probably originated in Chesapeake and/or Delaware Bay. It was concluded that unrestricted fishing for the striped bass that occur seasonally along the south shore of Long Island might be warranted. (Auth.)

10014. Forney, John L. (Dept. of Conservation, Cornell Univ., Ithaca, N.Y.). 1968. EFFECT OF DIFFERENT FERTILIZERS ON YIELD OF GOLDEN SHINERS IN NEW YORK PONDS. New York Fish and Game Jour., 15(1): 112-116.

Six ponds were stocked with adult golden shiners in 1953, and different fertilizers were applied. Heavy applications of inorganic fertilizers produced earlier and more pronounced plankton blooms than did lower applications in combination with manure, but standing crops in all ponds were similar at the end of one growing season. During the second year plankton blooms were consistently low in all ponds, whether fertilized with phosphorus and nitrogen or with phosphorus alone. However, the standing crop in all fertilized ponds increased from about 200 to 500 pounds per acre between the first and second growing seasons. At the end of 2 years, standing crops in the fertilized ponds were about three times that in an unfertilized control pond. (Auth.)

10015. Schaefer, Richard H. 1968. SEX COMPOSITION OF STRIPED BASS FROM THE LONG ISLAND SURF. New York Fish and Game Jour., 15(1): 117-118.

10016. Rickards, William L. (Inst. of Marine Sciences, Univ. of Miami, Miami, Fla.). 1968. ECOLOGY AND GROWTH OF JUVENILE TARPON, Megalops atlanticus, IN A GEORGIA SALT MARSH. Bull. mar. Sci., 18(1): 220-239.

Juvenile tarpon were found in both still and flowing dark water in marsh pools and creeks on Sapelo Island, Georgia. These fish grew approximately three centimeters per month. Two populations of juveniles were found during 1964: a resident population and a second one driven shoreward from the Gulf Stream by hurricane Dora. Tarpon from the second population grew approximately half as fast as those of the first population. Fish in the second influx encountered lower temperatures and less abundant food earlier in their existence than did those of the first population. The latter were probably the only ones to survive to migrate to warmer waters late in November. Postlarval tarpon are strictly carnivorous and they are predominantly piscivorous. The principal food varies with relative availability of different food organisms. The size of the food consumed is directly related to the size of the tarpon. Juveniles less than 125 mm in standard length consumed large numbers of ostracods; shrimps (Palaemonetes spp.) were eaten by tarpon longer than 76 mm in standard length. Fishes, mainly Gambusia affinis, were eaten by tarpon of all sizes sampled. Piscivorous birds appear to be the principal predators of juvenile individuals of Megalops. (Auth.)

10017. Gustafson, P. F., S. S. Brar, D. M. Nelson, and S. E. Muniak (Div. of Biology and Medicine, U. S. Atomic Energy Comm., Washington, D. C.). 1967. RADIOACTIVE ^{54}Mn AND ^{65}Zn IN EURYHALINE FISH. Canadian J. Zool., 45(5): 729-735.

Radioactive ^{54}Mn and (or) ^{65}Zn were found in the seven species of euryhaline fish examined; alewife, char, eel, salmon, shad, smelt, and sturgeon. These two radionuclides were not observed in any of the more than 30 stenohaline species investigated. Retention of ^{65}Zn was demonstrated only in euryhaline fish taken from a marine (saltwater) environment, whereas ^{54}Mn was retained by euryhaline fish living in either fresh or salt water. Their complex osmoregulatory systems, in addition to their feeding habits, are advanced as causal factors for the accumulation of ^{54}Mn and ^{65}Zn by euryhaline fish. Because shad and salmon (and probably both the sturgeon and char) were caught during the spawning migration there may be a hormonal influence as well on the metabolism of ^{54}Mn and ^{65}Zn. (Authors)

10018. Cartier, Denis, and Etienne Magnin (Dept. of Biology, Univ. of Montreal, Montreal, Quebec, Canada). 1967. THE GROWTH IN LENGTH AND IN WEIGHT OF Amia calva L. FROM THE MONTREAL REGION (La croissance en longueur et en poids des Amia calva L. de la région de Montréal). Canadian J. Zool., 45(5): 797-804.

The age of 80 bowfins (Amia calva L.) from the Montreal area has been read from the scales, the gular plate, and the otoliths. Both sexes have the same growth rate. The growth in length of all specimens collected can be summarized in one logarithmic equation: $\log L = 2.35137 + 0.54922 \log A$, where L is the total length (in mm) and A the age group. All the age groups can then be described by a particular measured mean length and also by a back-calculated mean length. The ponderal growth is obtained first from the mean weight of different classes, and then from the length-weight relation: $\log P = -4.961 + 2.992 \log L$, in which P is the weight (in g) and L the mean length (in mm) determined by back-calculation. Maximum length and weight recorded were 870 mm and 6,800 g respectively; a 12-year life span seems to be rarely exceeded. The results are compared with those available in the literature. (Authors)

10019. Snieszko, S. F., and G. L. Bullock (Bur. of Sport Fisheries and Wildlife, Kearneysville, W. Va.). 1968. FRESHWATER FISH DISEASES CAUSED BY BACTERIA BELONGING TO THE GENERA Aeromonas AND Pseudomonas. Bureau of Sport Fisheries and Wildlife, Fish Disease Leaflet 11. 7 p.

10020. Wilson, K.A., and K. Ronald (Dept. of Zoology, Univ. of Guelph, Guelph, Ontario, Canada). 1967. PARASITE FAUNA OF THE SEA LAMPREY (Petromyzon marinus von Linné) IN THE GREAT LAKES REGION. Canadian J. Zool., 45(6/1): 1083-1092.

Seven hundred and fifteen adult sea lampreys (Petromyzon marinus von Linné) from four streams tributary to Lake Huron and five offshore samples from the Manitoulin Island - Bruce Peninsula area, were examined for parasites. Dissection and microscopic examination revealed the presence of eight parasite species. Cucullanus stelmioides Vessichelli, 1910, is recorded for the first time both as a parasite of P. marinus and from North American waters. Ergasilus caeruleus Wilson, 1911, Anodontoides ferussacianus Lea, 1834, Diplostomum huronense (La Rue 1927), Plagioporus lepomis Dobrovolny, 1939, are all recorded for the first time as parasites of P. marinus. Echinorhynchus salmonis Muller, 1784, Triaenophorus crassus Forel, 1868, and Proteocephalus sp. are redescribed as parasites of the sea lamprey. (Authors)

10021. Margolis, L. (Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C., Canada). 1967. THE SWIMBLADDER NEMATODES (CYSTIDICOLINAE) OF PACIFIC SALMONS (GENUS Oncorhynchus). Canadian J. Zool., 45(6/2): 1183-1199.

Nematodes from the swimbladder of Oncorhynchus species are assigned to two genera: Cystidicola Fischer, 1798, and Salvelinema Trofimenko, 1962 (syn. Pseudometabronema Bogdanova, 1963). Cystidicola is represented in Asia by C. farionis Fischer, 1798 (syn. C. impar (Schneider, 1866)); specimens of this genus from Alaska could not be specifically identified because of immaturity. Cystidicola stigmatura (Leidy, 1886) occurs in North America within the range of Oncorhynchus but has not been found in this genus of fishes. Two species of Salvelinema are recognized: S. salmonicola (Ishii, 1916) Margolis, 1966, from Asia and North America, and S. walkeri (Ekbaum, 1935) n. comb. from North America. These two Salvelinema species and the immature Cystidicola sp. are described. Synonyms of S. salmonicola are Oxyuris sp. Koshida, 1905; Ancyracanthus s. Ishii, 1916; Cystidicola s. (Ishii, 1916) Fujita, 1927; Cystidicola chitosensis Fujita, 1940; "C. farionis" of Zhukov, 1960; S. cristata Trofimenko, 1962; and Pseudometabronema sachalinense Bogdanova, 1963. Synonyms of S. walkeri are Cystidicola walkeri Ekbaum, 1935, and "C. stigmatura" of Haderlie, 1953. Host and geographical distribution of the swimbladder nematodes of Oncorhynchus are reviewed. (Auth.)

10022. Price, Charles E., and Hisao P. Arai (Dept. of Biology, Augusta College, Augusta, Ga.). 1967. THE MONOGENEAN PARASITES OF CANADIAN FRESHWATER FISHES. Canadian J. Zool., 45(6/2): 1235-1245.

A brief history of work performed on the Monogenea of Canadian freshwater fishes is recounted; a list indicating the host — monogenean parasite relationships of Canadian freshwater fishes is included. Dactylogyrus albertensis sp. nov., recovered from the gills of the flathead chub, Hybopsis gracilis (Richardson), is described. Two additional known parasite species are recorded for Canada: (1) Pseudomurraytrema muelleri Price, 1967, recovered from Catostomus commersoni (Lacepede) and (2) Dactylogyrus banghami Mizelle and Donahue, 1944, recovered from Rhinichthys cataractae (Valenciennes). Hosts were collected from the Milk River in Alberta. (Authors)

10023. Arai, Hisao, and Rick H. Kussat (Dept. of Biology, Univ. of Calgary, Calgary, Alberta, Canada). 1967. OBSERVATIONS ON THE DISTRIBUTION OF PARASITES OF CERTAIN CATOSTOMID FISHES OF THE BOW RIVER, ALBERTA. Canadian J. Zool., 45(6/2): 1287-1290.

A survey of the helminth parasites of Catostomus commersoni (Lacepede), C. catostomus (Forster), and Pantosteus platyrhynchus (Cope) of the Bow River, Alberta, was carried out in 1965. The results obtained suggest that effluents discharged into the river at Calgary affect the distributional patterns of Octospinifer macilentus Van Cleave, 1919 and of Neoechinorhynchus cristatus Lynch, 1936 by exclusion of their intermediate hosts in the immediate vicinity of the city.

From the present data, however, we cannot completely eliminate the possibility that the size factor of fishes in the respective samples is not responsible for differences noted in the degree of parasitism in hosts from various localities along the course of the river. (Authors)

10024. Margolis, L. 1967. BLOOD FEEDING IN Salvelinema walkeri (NEMATODA:CYSTIDICOLINAE), A PARASITE OF COHO SALMON (Oncorhynchus kisutch). Canadian J. Zool., 45(6/2): 1295-1296.

10025. Benson, Norman G. (North Central Reservoir Investigations, Bur. of Sport Fisheries and Wildlife, Yankton, S.D.). 1968. REVIEW OF FISHERY STUDIES ON MISSOURI RIVER MAIN STEM RESERVOIRS. Bureau of Sport Fisheries and Wildlife Research Report 71. 61 p.

The six main stem Missouri River reservoirs are described, and information available through 1964 on plankton, water chemistry, fish populations, and water management is discussed. At maximum pool, these reservoirs have a capacity of 76 million acre-feet and a surface area of 1.2 million acres. Each of the upper reservoirs (Fort Peck, Garrison, and Oahe) is larger in capacity and area than the sum of the lower three reservoirs (Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake). Fishes common in this system are bigmouth buffalo, carp, river carpsucker, yellow perch, goldeye, northern pike, sauger, walleye, white crappie, black crappie, and freshwater drum. Available information on growth rates, year-class strength, and relative abundance of common species is described. Limiting factors of the environments are turbidities, wind, and fine soils. Research needs and problems relative to fish production are discussed. (Auth.)

10026. Anderson, D.V., and F.E.J. Fry (Dept. of Mathematics, Univ. of Toronto, Toronto, Ont., Canada). 1967. THE THERMAL REGIME OF GEORGIAN BAY (1953, 1954). Ontario Department of Lands and Forests Research Report No. 80. 7 p. Appendix.

Graphical summaries of surface temperatures and temperatures at depth for the whole Bay sampled at network points are given, as well as some commentary on the thermal meteorological environment of the Bay.

10027. Anderson, D.V. (Dept. of Mathematics, Univ. of Toronto, Toronto, Ont., Canada). 1967. DIURNAL MOTIONS OF THE THERMOCLINE OF LAKE ONTARIO CAUSED BY METEOROLOGICAL AND TIDAL FORCES. Ontario Dept. of Lands and Forests Research Report No. 77. 15 p.

Average water temperatures at the summer level of the thermocline at Toronto reveal correlation with the hour angles of both the sun and moon. Their forms are diurnal and it is suggested that the solar correlation has superimposed upon a gravitational tidal component a diurnal meteorological component due to the wind. (Auth.)

10028. Kennedy, W.A., and W.M. Sprules. 1967. GOLDEYE IN CANADA. Fisheries Research Board of Canada Bulletin 161. 45 p.

Goldeye, Hiodon alosoides, are found in turbid water, in several of the river systems of central North America. Of the four areas where most goldeye are produced commercially, growth is slowest in Sandy Lake, faster in Lake Claire, and fastest in Lake Winnipegosis and in the lower Saskatchewan River. They grow faster in the United States than in Canada. Females grow faster than males. Total mortality rate at ages 6-10 was 74% in a heavily exploited population, and 42% at ages 8-10, 48% at age 11, 57% at age 12, 73% at age 13, and almost 100% at age 14 in an unexploited population. Sex ratio is roughly 1:1. Spawning occurs between late May and the end of June, starting when the water warms to about 50-55° F. In the populations studied mature goldeye appear to spawn annually. Representative ovaries held 5,000-25,000 eggs about 1/12 inch in diameter. In the summer a wide range of organisms are eaten, including quantities from the water surface; in winter the diet seems restricted. Esox lucius, Stizostedion vitreum, and S. canadense are predators. Commercial production has declined greatly since 1929. Goldeye are particularly susceptible to overfishing and strict regulations are recommended. (Auth.)

10029. Borodicova, Nina D. 1968. THE BENTHIC POPULATION OF WATER BODIES IN THE BLATSKÁ DOLINA NEAR VIHORLAT (PRIOR TO CREATION OF THE STORAGE RESERVOIR.) Věst. Čs. spol. zool. (Acta soc. zool. Bohemoslov.), 32(2): 104-115.

The paper is concerned with materials on the species composition of benthic organisms which have inhabited the water reservoirs in the territory subsequently submerged by the Vihorlat storage reservoir. Due to varied conditions of habitation the population of the studied region proved to be ecologically diverse and adundant in species (137 forms). (Auth.)

10030. Holcik, Juraj. 1968. LIFE HISTORY OF THE PIKE—Esox lucius Linnaeus, 1758, IN THE KLÍČAVA RESERVOIR. Věst. Čs. spol. zool. (Acta soc. zool. Bohemoslov.), 32(2): 166-180.

The author deals with the life history of the pike—Esox lucius in the Klíčava Reservoir (spawning, activity, mortality, age and growth). The abundance of this species in Klíčava has decreased since 1957 more than 3 times which is due to the unfavorable spawning conditions in the reservoir. The growth of pike is rather lower than it was in 1957 in spite of the fact that the population density decreased and total abundance and ichthyomass of all fish stock in the Klíčava Reservoir is roughly the same as it was in 1957. The reason of this phenomenon is discussed.

10031. Hiyama, Yoshio, Toru Taniuchi, Kazuhei Suyama, Kiyohide Ishioka, Ryuhei Sato, Takeshi Kajihara, and Takashi Maiwa (Dept. of Fisheries, Faculty of Agriculture, Univ. of Tokyo, Tokyo, Japan). 1967. A PRELIMINARY EXPERIMENT ON THE RETURN OF TAGGED CHUM SALMON TO THE OTSUCHI RIVER, JAPAN. Bull. Jap. Soc. sci. Fish., 33(1): 18-19.

Thirty-two tagged mature male chum salmon from the Otsuchi River were released in Otsuchi Bay. Nasal capsules of 10 fish were plugged with cotton and vaselin to eliminate olfaction. Ten fish had both eyeballs covered with dark celluloid sheets to blind their vision. Twelve normal fish were utilized as controls. Within 4 days recovery was 58%. Chum salmon which had their olfaction ability eliminated showed no ability to return to their parent stream, although the fish which were blinded retained the ability to return there.

10032. Irie, Takaaki, Toru Yokoyama, and Tomoko Yamada. 1967. CALCIFICATION OF FISH OTOLITH CAUSED BY FOOD AND WATER. Bull. Jap. Soc. sci. Fish., 33(1): 24-26.

The effect of calcium quantity in food and water on the growth of carp otoliths were investigated using radioactive isotopes of ^{45}Ca. Results indicate that the calcium quantity deposited on the otolith from the food is twenty times greater than the quantity from water.

10033. Kaneko, Tokugoro, Masaaki Takeuchi, Seinosuke Ishii, Hideo Higashi, and Takaaki Kikuchi (Tokai Reg. Fish. Res. Lab., Chuo-ku, Tokyo, Japan). 1967. EFFECT OF DIETARY LIPIDS ON FISH UNDER CULTIVATION—III. EFFECT OF METHYL ESTERS OF HIGHLY UNSATURATED FATTY ACIDS, METHYL LINOLEATE AND METHYL PALMITATE ON THE FATTY ACID COMPOSITION OF RAINBOW TROUT FLESH LIPIDS. Bull. Jap. Soc. sci. Fish., 33(1): 47-56.

Fish divided into three groups were given diets containing methyl esters of highly unsaturated fatty acids (its main components are eicosapentaenoic acid and docosahexaenoic acid, 78.7% pure), methyl linoleate (83.8% pure) and methyl palmitate (93.7% pure) at 10%, respectively, for 10 weeks. Each group's diet was then changed to other ester and the experiment was continued for 10 more weeks. For both periods, approximately 400 grams of fish in each group were caught at 0, 4, 8 and 10 weeks. Lipids of flesh, liver and viscera were extracted by ethyl ether and oil contents were determined. Summarizing the results, when the fish were given methyl esters of highly unsaturated fatty acids or methyl linoleate, the corresponding fatty acids in flesh lipids increased rapidly. The acid in flesh lipids increased slowly in the group fed methyl palmitate. When fish which were first fed methyl esters of highly unsaturated fatty acids and distributed

richly such fatty acids in flesh lipids, were given methyl palmitate, the highly unsaturated fatty acids in flesh lipids decreased rapidly. As fish which stored a large amount of linoleate in flesh lipids, were given methyl esters of highly unsaturated fatty acids, both decrease of linoleate and increase of the highly unsaturated fatty acids in flesh lipids progressed slowly. The content of palmitic acid in flesh lipids of the fish which were not given methyl palmitate at both periods was more than 15%. The lowest level of linoleic acid content in flesh lipids of fish which were not given methyl linoleate on all periods was 9%. The level of the highly unsaturated fatty acids in flesh lipids of fish that were not given methyl esters of the highly unsaturated fatty acids at both periods, was maintained at 5%.

10034. Kaneko, Tokugoro, Masaaki Takeuchi, Seinosuke Ishii, Hideo Higashi, and Takaaki Kikuchi (Tokai Reg. Fish. Res. Lab., Chuo-ku, Tokyo, Japan). 1967. EFFECT OF DIETARY LIPIDS ON FISH UNDER CULTIVATION—IV. CHANGES OF FATTY ACID COMPOSITION IN FLESH LIPIDS OF RAINBOW TROUT ON NON-FEEDING. Bull. Jap. Soc. sci. Fish., 33(1): 56-58.

Rainbow trout (Salmo gairdneri) were fed diets containing three kinds of methyl esters of fatty acids for a 10-week experimental period and then were starved for 10 weeks. Changes of the fatty acid composition in the flesh lipids caused by starvation were observed. Loss of weight of fish in three experimental groups showed little difference during starvation. The fish fed methyl esters of highly unsaturated fatty acids before starvation did not decrease their oil content in the flesh. Throughout the experimental groups, the highly unsaturated fatty acid content in the flesh lipids increased during starvation.

10035. Ueda, Tadao, Yutaka Shimizu, and Wataru Simidu (Ajinomoto Central Lab., Kawasaki, Japan). 1967. EXTRACTABILITY OF FISH ACTIN. Bull. Jap. Soc. sci. Fish., 33(1): 59-64.

Fish actin was extracted from acetone dried muscle. The components of the extracts were supposed to be F-actin and tropomyosin by electrophoretic determination. Comparison of fish actin content was made on various species, however, no species difference in actin content was found. (Authors summ.)

10036. Enomoto, Yoshimasa (Tokai Reg. Fish. Res. Lab., Chuo-ku, Tokyo, Japan). 1967. ON THE EFFECT OF THE SOMATOTROPIC HORMONE TO THE URINE ELECTROLYTES OF RAINBOW TROUT. Bull. Jap. Soc. sci. Fish., 33(2): 71-73.

A modified cannulation technique to collect urine from Salmo gairdneri was shown in comparison with the original method. The intraperitoneal injection of the bovine somatotropic hormone followed a remarkable increase of chloride excretion of the urine in Salmo gairdneri. (Auth. summ.)

10037. Yamashita, Hideo (Seikai Reg. Fish. Res. Lab., Nagasaki, Japan). 1967. HAEMATOLOGICAL STUDY OF A SPECIES OF ROCKFISH, Sebasticus marmoratus—I. THE EFFECT OF CHLORINITY ON THE MOISTURE CONTENT AND SPECIFIC GRAVITY OF BLOOD, SERUM PROTEIN AND ERYTHROCYTE COUNTS. Bull. Jap. Soc. sci. Fish., 33(2): 81-90.

An experimental study on the influence of changes in chlorinity on the haematological characteristics of Sebastiscus marmoratus was carried out with the hope that these might reveal ecological factors controlling the distribution of these fish in the sea. In the experiments with considerably lower (8.22-8.34°/oo) or higher (22.31-22.47°/oo) chlorinities than that in the natural habitat 17.60-17.72°/oo) of S. marmoratus, the entire body surface of each specimen was covered by a transparent mucous film. This seemed to regulate the osmotic mechanism against extreme changes in salinity. Feeding activities and swimming movements were markedly decreased. Indeed, there was scarcely any movement at all. The chlorinity values, therefore, appear to indicate the approximate upper or lower limits of chlorinity tolerance for this species. No correlation was observed between the fluctuation of the quantity of serum protein and the chlorinity. On the other hand, a very high positive correlation was found between the specific gravity

of the blood and the chlorinity of the water. Thus the specific gravity of blood increased with increasing, or decreased with decreasing chlorinity in the water, but a negative correlation was clearly found between the specific gravity and the moisture content of blood. Consequently, these relations may indicate that the chlorinity changes in the fishes' habitat would cause physiological readjustment of the moisture content of blood. When the fishes were kept in more or less saline water than that of their natural habitat, a positive correlation was found between the specific gravity and the serum protein of blood. The interrelation between the serum protein and the moisture content of blood was, however, negative with one exception. When S. marmoratus was not subjected to any change in the chlorinity of the water, i.e., they were kept in natural sea water, the correlation coefficients calculated for three blood elements were conspicuously higher than those obtained for specimens reared with the water of abnormal chlorinities. The slight individual variability in these values might indicate stability of the blood elements under such circumstances. When the water was more or less saline than normal, on the other hand, there were irregularities in the correlation coefficients of the blood elements in each fish. The balance of elements thus seems to be unstable under such conditions. The amount of serum protein in the female was consistently greater than that of the male. In both sexes, the quantities increased gradually with the development of the gonads and reached a maximum during maturation.

10038. Niwa, Hiroshi, and Tamotsu Tamura (Fisheries Lab., Faculty of Agric., Nagoya Univ.). 1967. INVESTIGATION OF FISH VISION BY MEANS OF S-POTENTIAL—I. RELATIONSHIP BETWEEN THE AMPLITUDE OF S-POTENTIAL AND THE INTENSITY OF ILLUMINATION. Bull. Jap. Soc. sci. Fish., 33(2): 91-97.

L-response of the S-potentials, which is considered as an indicator of luminosity sensation, was used to study the relationship between the amplitude and the intensity of illumination. The intensity to produce a half of the maximum amplitude was measured in five species. The intensities thus obtained were higher in the order of mullet, carp, goldfish, sting-ray and neko-shark. The latency of returning phase at the cessation of the stimulus was found to be shorter in the same order as above. These results were discussed in reference to ecological aspects of fishes. It is concluded that the five fishes used in this study adapt themselves to the brighter environment in the order of mullet, carp, goldfish, sting-ray and neko-shark. (Authors summ.)

10039. Ikeda, Shizunori, and Sadao Shimeno (Dept. of Fisheries, Faculty of Agric., Kyoto Univ., Maizuru, Japan). 1967. STUDIES ON GLUCOSE-6-PHOSPHATASE OF AQUATIC ANIMALS—I. PROPERTIES OF HEPATIC GLUCOSE-6-PHOSPHATASE OF FISHES. Bull. Jap. Soc. sci. Fish., 33(2): 104-111.

Glucose-6-phosphatase, catalyzing specific hydrolysis of glucose-6-phosphate, was found in the liver of flying fish and yellowtail. Its optimum pH and temperature lay at pH 6.0 and 40° C, respectively. As a result of study on intracellular distribution of the enzyme, the highest specific activity was found in "Heavy microsome fraction", in which 35% of the total activity was found. The enzyme activity was rapidly decreased by preincubation at pH 4.0-5.5, but relatively stable at pH 7.5. Apparent Michaelis constant was 3.6×10^{-3} M. The enzyme activity was scarcely inhibited by glucose and inorganic phosphate at the low concentration, but considerably at the high concentration of glucose. Other hexoses and pentoses did not inhibit so much as glucose. The enzyme activity was strongly inhibited by Mo^{6+}, Hg^{++}, and Cu^{++} at 10^{-2} - 10^{-3} M, but neither stimulated nor inhibited by Ca^{++} and Mg^{++}. (Authors summ.)

10040. Shimeno, Sadao, and Shizunori Ikeda (Dept. of Cultural Fisheries, Faculty of Agric., Kochi Univ., Nangoku, Kochi Pref., Japan). 1967. STUDIES ON GLUCOSE-6-PHOSPHATASE OF AQUATIC ANIMALS.—II. THE ENZYME ACTIVITIES IN FISH TISSUES. Bull. Jap. Soc. sci. Fish., 33(2): 112-116.

The highest level of G6Pase activity in fish organs was found in liver, and low levels in kidney, digestive tract, pyloric caecum, and dark meat. But the

enzyme was not detected in heart tissue and ordinary meat. In the tested condition, the livers of marine or migratory fishes showed higher G6Pase activity than those of fresh-water or non-migratory fishes, respectively. (Authors summ.)

10041. Ishii, Takeo (Ocean Research Inst., Univ. of Tokyo, Nakano, Tokyo, Japan). 1967. STUDIES ON ESTIMATING PARAMETERS OF A FISH POPULATION SUPPLIED BY SEQUENTIAL RECRUITMENT—I. THE EFFECT ON ESTIMATES FOR PACIFIC YELLOWFIN TUNA. Bull. Jap. Soc. sci. Fish., 33(6): 513-523.

In tuna longline fishery, yellowfin tuna seem not to be recruited fully at a certain age, but sequentially over some years. The bias of estimated value of parameters by two ordinary methods, especially of the natural mortality coefficient (M), in age at which the recruitment is not completed is evaluated by simulation. When the rate of recruitment is derived from the normal distribution assuming that the fish recruits from Age 1 to Age 5 and the mode of recruitment is at Age 3, $\hat{M}$ in Ages 1 and 2 was impossible to obtain, and $\hat{M}$ in Ages 3 and 4 are smaller than M in each case. The bias of $\hat{M}$ in ages older than 4 is negligible. When the rate of recruitment calculated from the catch data and given values of M and q are used, $\hat{M}$ in Ages 3 and 4 are different from the given value, and that bias of $\hat{M}$ varies in each subarea. In the subarea where the rate of recruitment changed, the variation is remarkable. In a fish population which has sequential recruitment, it is necessary to formulate a new method of estimating population parameters. (Auth. summ.)

10042. Shimizu, Masanao, and Yoshiyuki Takase. 1967. A POTENT CHEMOTHERAPEUTIC AGENT AGAINST FISH DISEASES: 6-HYDROXYMETHYL-2[2-(5-NITRO-2-FURYL) VINYL] PYRIDINE (P-7138). Bull. Jap. Soc. sci. Fish., 33(6): 544-554.

6-Hydroxymethyl-2[2-(5-nitro-2-furyl) vinyl] pyridine (P-7138) showed the inhibitory activity in vitro at low concentrations (1 mcg/ml or less) against most of the tested gram positive and negative bacteria including several strains isolated from fishes and was also active in vitro against fungi and trichomonas. This agent exhibited the therapeutic effect by both oral administration and bathing in fishes infected with Aeromonas liquefaciens. The effect by bathing was excellent in low concentrations. Distribution and toxicity of this agent in fishes were also investigated. (Authors summ.)

10043. Ogawa, Yoshinori. 1967. EXPERIMENTS ON THE ATTRACTIVENESS OF ARTIFICIAL REEFS FOR MARINE FISHES—VII. ATTRACTION OF FISHES TO THE VARIOUS SIZES OF MODEL REEFS. Bull. Jap. Soc. sci. Fish., 33(9): 801-811.

Using stone bream, Oplegnathus fasciatus, striped pigfish, Parapristipoma trilineatum, common sea bass, Luteolabrax japonicus, leather fish, Stepthanolepis cirrhifer, gray rock cod, Sebastes inermis, and so on, experiments were carried out in an outdoor water tank (L. 8 x W. 6 x D. 1.5 m) with pooled water, in order to obtain fundamental information about the influences of various dimensions of fish reefs, both horizontally and vertically, to the reaction of fish schools. Stone bream, striped pigfish and common sea bass were attracted samely to the various distances between model fish reefs, both horizontally and vertically. In other words, two seemingly different factors, the one being the increase of height and the other the increase of horizontal area, have the same values of stimulus to the mentioned species of fishes. Seigo, the young of common sea bass, was more attracted to the increase of height than that of area of model fish reefs. Leather fish was more attracted to the increase of horizontal area than that of height of model fish reefs. Stone bream was attracted samely to the blocks, even if the blocks were set in a distance one to one and half the heights of the blocks. Striped pigfish was obviously less attracted to the blocks when they were set at a distance more than the heights of the blocks. Gray rock cod was hardly attracted to the model fish reefs used in the present report. It was rather attracted to the shadow of the water tank.

10044. Kariya, Teiji, Yoshiko Haga, Hideo Haga, and Tsutomu Tsuda. 1967. STUDIES ON THE POST-MORTEM IDENTIFICATION OF THE POLLUTANT IN THE FISH KILLED BY WATER POLLUTION—V. DETECTION OF COPPER IN THE FISH. Bull. Jap. Soc. sci. Fish., 33(9): 818-824.

An attempt was made to determine the quantity of copper in a fish's body by the sodium-diethyl-dithiocarbamate method. Normal fish contained less than 2.2 γ/g copper per body weight, with an average of 1.35 γ/g. Excessive copper content was regarded as follows: Excessive copper content = Determined copper content - 2.2 (γ/g). After a fish died in various concentrations of $CuSO_4$ within 48 hours, copper content in the body was determined at once or after washing in running tap water for 24 hours. Utilizing this method it was possible to detect the excessive copper content in every case. Post-mortem identification of copper in the bodies of fishes killed by acidic-copper-plating and alkaline-copper-plating solutions was also possible. In case of a brass-plating solution it was possible in higher concentrations, but often impossible in lower concentrations. However, even in case of the low concentrations, CN was detected from the fish body killed in it.

10045. Watanabe, Takeshi, Takao Tsuchiya, and Yoshiro Hashimoto. 1967. EFFECT OF DPPD AND ETHOXYQUIN ON THE MUSCULAR DYSTROPHY OF CARP INDUCED BY OXIDIZED SAURY OIL. Bull. Jap. Soc. sci. Fish., 33(9): 843-847.

It was previously observed that the synthetic antioxidants, methylene blue, BHA and ethyl gallate, are all ineffective on muscular dystrophy of carp induced by oxidized saury oil and that methylene blue promotes the disease. Succeeding to previous work, the effect of DPPD and ethoxyquin was compared with that of DL-α-tocopheryl acetate on the muscular dystrophy of carp and that of methylene blue was reexamined. Both antioxidants, DPPD and ethoxyquin did not counteract the action of oxidized saury oil and the former killed carp in 30-40 days at the level of 250 mg%. When kept on a diet containing 120 mg% of methylene blue, carp showed a typical sign of the disorder in 7 days and the rate of diseased fish exceeded 90 percent in 20 days. A high blood glucose level was observed in the lots, in which fish showed a high percentage of muscular dystrophy.

10046. Okutani, Koichi, Izumi Kawada, and Masao Kimata (Dept. of Fish., Fac. of Agr., Kinki Univ., Osaka, Japan). 1967. STUDIES ON CHITINOLYTIC ENZYME PRESENT IN AQUATIC ANIMALS—V. THE CHITINOLYTIC ENZYME PRESENT IN THE DIGESTIVE TRACTS OF YELLOW TAIL. Bull. Jap. Soc. sci. Fish., 33(9): 848-859.

In a previous paper the authors reported that the chitinolytic enzyme is present in some organs of a few kinds of aquatic animals. Recently, it has been reported that in the digestive tracts of Japanese sea-bass, Lateolabrax japonicus, chitin seems to be decomposed simultaneously by both bacterial and non-bacterial actions. The present study was carried out in order to ascertain whether similar chitinolytic systems are present in yellow tail, Seriola quinqueradiata. This paper is concerned with both chitinolytic enzyme of non-bacterial origin in the stomach and chitin-decomposing bacteria present in the digestive tracts. Results obtained were as follows: The chitinolytic enzyme of high activity is present in the stomach but not in the pyloric caeca and intestine; the optimum pH value for the action of the enzyme is about 4.0, and the optimum temperature is about 50° C; the enzyme is stable at pH 3.0-4.0 at 22° C at least for 24 hours; most or many of the bacterial cells present in the digestive tracts are occupied by chitin-decomposing ones; the optimum pH values for the action of the enzyme of bacterial origin is about 7.0, and the optimum temperature is about 40° C, both being in sharp contrast to those of the enzyme of non-bacterial origin.

10047. Cross, Frank B. 1967. HANDBOOK OF FISHES OF KANSAS. Misc. Pub. No. 45., Univ. of Kansas Museum of Natural History, 357 p.

10048. Hattori, Shigemasa, and Hidetsugu Katoh. 1966. SURFACE CURRENT IN THE SOUTHERN WATERS OFF JAPAN VIEWED FROM DRIFT BOTTLE EXPERIMENT, WITH SPECIAL REFERENCE TO TRANSLOCATION OF FISH EGGS AND LARVAE. Bull. Tokai Reg. Fish. Res. Lab. No. 45. pp. 1-30.

The drift bottle experiments were undertaken in winters (February-March) 1956-1962 during the survey cruises by the R.V. Soyo-Maru for the important coastal fisheries resources. Recoveries show remarkable fluctuation by year and by area. The recovery rate for bottles released in the area extending from the Sea of Hyuga-Nada and south of Shionomisaki is extremely low (9-10%) and those in the Satsunan, south of Izu and Boso Peninsulas, are as high as 50-54%. The recovery rates for the years 1957 (released at the south off Honshu) and 1958 (released at Satsunan Area) were about 10%. but those for 1959 onwards were 4-6% as the bottles were released from many stations off the Pacific coast of Honshu. Recovery ratio of bottles released from Satsunan and recovered at the south of Izu and Boso Peninsulas is as low as 0.39%. Surface current speed was estimated by the bottles that drifted further than 100 miles away. The modes appear 4-6 miles per day, 10-12 m.p.d. and 20-24 m.p.d.. The largest mode (20-24 m.p.d.) was approximately the same as the actual GEK measurement. From these results, the surface current by drift bottles are closely related to oceanographical and meteorological conditions. The drift of the bottles in summer are different from that of the winter seasons as the monsoon exerts some effects. The fluctuation of recovery sites are well correlated to the meander of the Kuroshio. Further, the translocation of fish eggs and larvae by the current in connection with surface current is studied by taking the problem of sardine, anchovy, and mackerel populations into consideration.

10049. Ogawa, Yoshinori, and Yoshio Takemura. 1966. EXPERIMENTS ON THE ATTRACTIVENESS OF ARTIFICIAL REEFS FOR MARINE FISHES—I. PRELIMINARY OBSERVATIONS ON SMALL MODELS IN THE LABORATORY. Bull. Tokai Reg. Fish. Res. Lab. No. 45. pp. 107-113.

A series of experiments were carried out to gather biological information to find the most suitable structure and size of the artificial reefs to attract fishes and, in addition, to know the physiological mechanism involved in the attraction of fishes to the artificial reefs. This paper deals with the preliminary observations on small models (20 x 20 x 15 cm) put in a steel-framed glass aquarium (180 x 50 x 45 cm). Three species of fish were selected for the observation. They were Girella punctata (90-120 mm in length), Parapristipoma trilineatum (110-127 mm in length) and Oplegnathus fasciatus (100-120 mm in length). Usually 10 or 20 fishes were used at a time. Records of distribution of experimental fishes in the aquarium were taken from the side on photo-films by means of an automatically controlled camera, of which the detailed description will be made in the second paper of this series. The effects of the models to the behavior of experimental fishes were evaluated by the change of distribution of fishes. When there were no models in the aquarium the distribution pattern was taken as standard. When the model reefs were put in the aquarium, considerable changes were nearly always observed in the distribution of experimental fishes, and the percentage of fishes in the division where the models were placed increased. Effectiveness of model reefs to attract fishes did vary depending on the shape and size of the models, but the variation was irregular and conflicting. It was not possible, therefore, to identify the condition of model reefs which might have a decisive effect on the attraction of fishes.

10050. Takemura, Yoshio, and Yoshinori Ogawa. 1966. EXPERIMENTS ON THE ATTRACTIVENESS OF ARTIFICIAL REEFS FOR MARINE FISHES—II. AN AUTOMATIC RECORDING APPARATUS. Bull. Tokai Reg. Fish. Res. Lab. No. 45. pp. 115-126.

In order to avoid the disturbance by human presence the mode of distribution of the experimental fishes in the aquarium was recorded by means of an automatic recording apparatus, which consisted of a camera (Nikon-F) with a motor-driven device and a speed-flash system connected to the camera. The intervals of signals

sent to the recording apparatus were regulated by means of a remote control system set in the other room, consisting of a single article, or two or more, or a combination of, a clock-type time switch, a modified time signal machine, an electronic autotimer and an intervalmeter of special construction for the present purpose. This paper represents a part of the data obtained on "Mejina", Girella punctata, by the recording apparatus. This apparatus was mainly used for indoor glass aquaria, but was applicable for outdoor tanks also.

10051. Takayama, S., Miyazaki, C., Yazima, S., Koyama, T., Mitsugi, S., and Yoshimuta, C. 1967. STUDIES ON BEHAVIOR OF FISH SCHOOLS IN THE WATERWAY OF AN EXPERIMENTAL POND WITH WARM AND COLD WATER. Bull. Tokai Reg. Fish. Res. Lab. No. 49. pp. 91-98.

Investigations were made to determine if it is possible to gather fish schools or stop their movements around the waterway of an experimental pond where warm and cold water converge. One experiment was conducted with a board fixed at the area where the warm water and cold water converged, and in the other experiment the board was eliminated. The waterway was designed for both warm and cold water to stream simultaneously at the area. Before each experiment, water temperatures of the upper, middle and lower layers of the waterway and their current velocity and volume were measured. Rainbow trout, about 20 cm in body length which had been raised in ponds with the water temperatures of 16.5°-21.0° C and 9.0-11.5° C, were used for the experiments, and 10 rainbow trout raised at the former and latter temperatures were freed to observe their behavior for five minutes and count their number at the intervals of 20 seconds. The average number of fish which swam through the points per observation was calculated. The calculated number of fish implies the distribution of the fish movements. The results of the experiments were as follows. When a board was fixed at the waterway of the experimental pond, the warm water met the cold water around the central area of the waterway. The fish, which had been raised in the warm water, gathered at the boundary between the warm water and the cold water in the area which temperature was rather lower than that of the pond where the fish had been raised, but the fish raised in the coldwater converged in the cold water side. When no board was fixed at the boundary between the warm water and cold water, the two waters met each other at the boundary. The fish gathered around the boundary between the warm and cold water scattering more widely than when the board was used. They gathered at the waterway where the temperature was rather lower than that of the pond in which they had been raised. Neither fish having been raised in the warm water nor ones in the cold water gathered densely at one area of the waterway of the experimental pond. In both trials fewer fish swam into the warmer water than into the water of temperature in which they had been raised before the experiments.

10052. Ogawa, Yoshinori, and Yoshio Takemura. 1966. EXPERIMENTS ON THE ATTRACTIVENESS OF ARTIFICIAL REEFS FOR MARINE FISHES—III. OBSERVATIONS ON STONE BREAM IN THE OUTDOOR TANK. Bull. Tokai Reg. Fish. Res. Lab. No. 45. pp. 127-135.

Model reefs of two sizes and of various structures were tested for the attractiveness for stone bream, Oplegnathus fasciatus, in an outdoor tank. Ten fish were put in the tank at a time. They gathered to form and maintain a single school. The experimental fish were inspected 100 times at one minute intervals and records were kept of the location of the school of fish. Effectiveness of the model reefs to attract stone bream was evaluated by the frequency with which the school visited the division where the models were located. The results showed smaller models (15 x 15 x 15 cm) attracted smaller fishes of about 140 mm in total length, but could not attract the larger fishes of about 210 mm in total length. Larger models (60 x 60 x 45 cm) attracted the larger fishes as well as the smaller ones. Stone bream showed a marked preference for the model reef put in the center of the tank. The school of stone bream visited the models of complicated structure far more frequently than those of simple structure. The structure and size of the model reefs had a decisive effect on the attraction of the fish.

10053. Ogawa, Yoshinori. 1966. EXPERIMENTS ON THE ATTRACTIVENESS OF ARTIFICIAL REEFS FOR MARINE FISHES—IV. ATTRACTION OF STONE BREAM AND RUDDERFISH TO BLACK OBJECTS ON THE WHITE BACKGROUND. Bull. Tokai Reg. Fish. Res. Lab. No. 45. pp. 137-145.

Both stone bream and rudderfish were attracted to a sheet of black plastic plate put on the bottom of a tank, the inside of which was painted white. Feeding stimulus did not seem to explain the "picking" behavior of stone bream and rudderfish to a lustrous black plate. Stone bream disputed territory on the black plate. In the case of rudderfish the picking behavior to a lustrous black plate could be explained by a schooling behavior. Rudderfish were strongly attracted to black objects, while stone bream were more attracted to reddish-brown or white objects than to the black one. This experiment throws some doubt on hitherto accepted "habitat" theory put forth by Ohshima for the attraction to black objects on a white background.

10054. Coche, Andre G. (Oregon State Game Comm., Research Div., Corvallis, Oreg.). 1967. PRODUCTION OF JUVENILE STEELHEAD TROUT IN A FRESHWATER IMPOUNDMENT. Ecological Monographs, 37(3): 201-228.

Dynamics of survival, growth, and production of a juvenile steelhead population were investigated between June 1962 and March 1963 in an impoundment near Roseburg, Oregon. The pond was 13.3 ha (32.9 acres), the mean depth 2.45 m. Maximum water temperature reached 26° C in late July but never extended more than 1 m in depth. In summer, the temperature of the water mass varied between 20 and 24° C. A 4° C minimum temperature was observed for a short period in January. A dissolved oxygen content of less than 5 mg/l occurred only in midsummer, at depths greater than 3.5 m. Surface pH of the water was alkaline but showed great variation from month to month. The pond was stocked with 15-day fed fry at an average rate of 8,000 fish/ha. At the end of 302 days of rearing, 39,000 sub-smolts averaging 10 cm in length were harvested. The total survival was 38.4%. Main cause of fish loss was predation by mergansers, herons, kingfishers, and adult bullfrogs. The average condition factor ranged from 0.89± 0.013 to 1.14± 0.033. The average biomass varied between 5.9 and 31.6 kg/ha (late September). The average standing crop for the year was 25 kg/ha. Trout production reached its maximum value in late July (7.4 kg/ha). The total production (302 days) amounted to 619 kg (47.6 kg/ha), of which 79% was elaborated in summer. Mortality was maximal in September. Total mortality amounted to 256 kg (19.7 kg/ha). At the end of the rearing period, the trout yield was 363 kg (28 kg/ha), corresponding to 59.4% of the total production. The crop was 393 kg (30.2 kg/ha). A study of the effect of draining revealed that only the Anisoptera nymphs showed a tendency to be drained from the pond. Some managed to stay alive until the water level reached them again during refilling. A study of the stomach contents of juvenile trout showed that they relied mainly on benthic insects.

10055. Murphy, Garth I. (Dept. of Oceanography, Univ. of Hawaii, Honolulu, Hawaii). 1967. VITAL STATISTICS OF THE PACIFIC SARDINE (Sardinops caerulea) AND THE POPULATION CONSEQUENCES. Ecology, 48(5): 731-736.

The population parameters of the Pacific sardine are estimated from growth, mortality, and fecundity data, together with the increase per generation R_o estimated by fitting the Ricker equation. R_o is 4.01, r_m is .388 and generation time, T, is 4.1 yr. The estimation of these parameters for a large natural population (equilibrium level about 2.4×10^6 tons) was possible because of a well-documented fishery. The environmentally induced, density independent variation in reproductive success is in the order of eight times. In theory, an organism can better tolerate widely variable reproductive success if there is repeated reproduction. Exploitation to collapse following two consecutive, unsuccessful spawnings. The Ricker function generates a population growth curve not unlike the logistic at low values of r_m. Even if fishing were stopped, the recovery of the population would require more than a decade. It will likely be even slower, as a species with similar ecological requirements (the northern anchovy) has increased by a factor of five following the decline of the sardine, undoubtedly preempting resources once available to the sardine. (Auth.)

10056. Stephens, K., R.W. Sheldon, and T.R. Parsons (Fish. Res. Bd. Canada, Pacific Oceanographic Group, Nanaimo, B.C., Canada). 1967. SEASONAL VARIATIONS IN THE AVAILABILITY OF FOOD FOR BENTHOS IN A COASTAL ENVIRONMENT. Ecology, 48(5): 852-855.

The quantity of suspended and deposited particulate material was measured over a period of 1 year in a coastal environment. Maximum deposition of sediment occurred during the periods May to July, and October to December. The first maximum occurred approximately 2 months after the spring phytoplankton bloom and consisted largely of phytogenous material. The total quantity of this material deposited represented approximately half of the annual primary production. The second sediment maximum was due to terrigenous material from the immediate vicinity of the coast. (Authors)

10057. Dimond, John B. (Dept. of Entomology, Univ. of Maine, Orono, Me.). 1967. EVIDENCE THAT DRIFT OF STREAM BENTHOS IS DENSITY RELATED. Ecology, 48(5): 855-857.

The abundance of bottom fauna and of fauna in drift was studied in streams treated with DDT at various times in the past. Recovery of the bottom fauna was found to be rapid, but that of drift was delayed. The relationship of quantity of drift to the increasing bottom standing crop during recovery from spray effects was found to be curvilinear. This suggested that drift is a density-related process. Possible mechanisms to explain drift are discussed, and the conclusions of earlier reports on recovery of streams following insecticidal treatment are questioned. (Auth.)

10058. Carlander, Kenneth D., Clarence A. Carlson, Vijaya Gooch, and Thomas L. Wenke (Iowa Cooperative Fishery Unit, Iowa State Univ., Ames, Iowa). 1967. POPULATIONS OF Hexagenia MAYFLY NAIADS IN POOL 19, MISSISSIPPI RIVER, 1959-1963. Ecology, 48(5): 873-878.

June populations of Hexagenia naiads in Pool 19 of the Mississippi River were estimated at 3.6, 18.7, 6.7, 23.6 and 11.9 billion in 1959 to 1963, suggesting an alternate year cycle of abundance. Although population density varied in different sections of the river, little pattern was evident. Water depths from 0.5 to 6 m and bottom deposits from soft mud to soft muds with shells or plant debris had little consistent relation to population density. Sand and gravel areas had few or no Hexagenia. Naiads increased in average size in June. In late July after major emergences, there were few naiads collected, but small naiads increased in August. Flood may have shifted part of the population in 1960. Tendipes plumosus larvae were more abundant in 1961, when Hexagenia populations were lower, than in 1960. Usually H. limbata was the more abundant species (among naiads over 16 mm) in early June and in August and H. bilineata, in late June and July. Sex ratios were usually near 50:50. (Authors)

10059. Maciolek, J.A., and M.G. Tunzi (Bur. of Sport Fisheries and Wildlife, Bishop, Calif.). 1968. MICROSESTON DYNAMICS IN A SIMPLE SIERRA NEVADA LAKE-STREAM SYSTEM. Ecology, 49(1): 60-75.

Suspended organic particles in a small, precipitous drainage were studied primarily in regard to trophic ecology. Headwater and seepage sources in the 6.5-km (4-mile) system contained minimal quantities (<2 gcal/liter or 0.5 mg/liter dry wt) mainly of organic detritus. Maximum concentration (>12 gcal/liter or nearly 3 mg/liter dry wt) appeared in the stream as effluent phytoplankton from the single lake located near the headwaters. A progressive decrease in cellular microseston below the lake was accompanied by an increase in detritus. The cell loss was due mostly to trophic uptake by filter-feeding simuliid larvae which were capable of removing 60% of the suspended algae within a 0.4-km section of stream. Downstream gain of organic detritus resulted from external contributions (e.g. streamside vegetation), abetted by decompositional processes within the stream, including digestion by aquatic invertebrates. Autochthonous material was considerably less important quantitatively as seston than allochthonous (lacustrine and terrestrial). Sedimentation and physicochemical loss were secondary to

trophic uptake in seston removal. Destruction of cellular material by turbulent flow was directly proportional to stream gradient and was clearly evident only where a prolonged gradient existed in excess of 5%. Because all loss-causing factors operate selectively on cellular material, organic detritus would be expected as the chief microseston component of streams isolated from lake outflow. (Authors)

10060. Pearson, William D., and Donald R. Franklin (Utah Cooperative Fishery Unit, Utah State Univ., Logan, Utah). 1968. SOME FACTORS AFFECTING DRIFT RATES OF Baetis AND SIMULIIDAE IN A LARGE RIVER. Ecology, 49(1): 75-81.

Effects of eight factors on the drift rates of Baetis nymphs and Simuliidae larvae were tested with multiple regression analyses. Illumination, population density of all other organisms and temperature had significant influences on drift rates of both organisms. Turbidity and water-level fluctuations were related to changes in drift rates indirectly through influence upon light penetration and population density, respectively. Dissolved-oxygen concentration, calendar date, and depth of water at the sample site did not clearly affect drift rates of either organisms. In areas where population densities were high, the eight factors tested accounted for 65% to 81% of the variability observed in drift rates. Maximum drift rates were 170×10^6 Baetis sp. nymphs (63.2 kg) and 10.9×10^6 Simuliidae larvae (5.4 kg) per day. (Authors)

10061. Waters, Thomas F. (Dept. of Entomology, Fisheries, and Wildlife, Univ. of Minnesota, St. Paul, Minn.). 1968. DIURNAL PERIODICITY IN THE DRIFT OF A DAY-ACTIVE STREAM INVERTEBRATE. Ecology, 49(1): 152-153.

Diurnal periodicity in the drift of invertebrates was observed in Temple Fork (of the Logan River), a small Utah mountain stream in the summer of 1966. The larvae of a caddisfly, Oligophlebodes sigma Milne (Trichoptera:Limnephilidae) exhibited a marked day-active drift periodicity, a type rarely reported. Drift rates as high as 400 g (160,000 individuals) per 24 hr for the entire stream (discharge about 0.34 m^3/sec) were recorded, with only 4% occurring during the night. Inflections in drift rate were not related to times of sunset or sunrise, as is the case with night-active species. Rather, a close positive correlation with water temperature, normally higher during the daytime, was apparent. Such correlation suggests that, whereas light intensity is the phase-setting mechanism for night-active drift periodicities, in the present case of a day-active pattern, the phase-setting mechanism was water temperature. (Auth.)

10062. O'Hara, James (Dept. of Biological Sciences, State Univ. of New York at Albany, Albany, N.Y.). 1968. THE INFLUENCE OF WEIGHT AND TEMPERATURE ON THE METABOLIC RATE OF SUNFISH. Ecology, 49(1): 159-161.

Oxygen consumption was determined for sunfish between 1.4 and 116.0 g at 25° and 30° C. Metabolic rates of smaller fish are less affected by temperature change than those of large fish. Interspecific comparison indicates that bluegills (Lepomis macrochirus) are better adapted to higher temperatures than pumpkinseeds (L. gibbosus). (Auth.)

10063. Sheldon, Andrew L. (Section of Ecology and Systematics, Cornell Univ., Ithaca, N.Y.). 1968. SPECIES DIVERSITY AND LONGITUDINAL SUCCESSION IN STREAM FISHES. Ecology, 49(2): 193-198.

A quantitative survey was made of the distribution and abundance of fishes in Owego Creek, New York. Four of the five headwaters species occurred throughout the area and two of these species dominated the fauna in all areas. Thirty-one species were found in the area. Succession took the form of additions to the headwaters assemblage and replacement was of minor importance. Regression analyses show that the number of species in any area was correlated most strongly with stream depth although an effect of position was also significant. Species diversity (information theoretic) was independent of position and depended on depth along. Behavioral observations support the importance of the depth factor. (Auth.)

10064. Patrick, Ruth, John Cairns, Jr., and Selwyn S. Roback (Dept. of Limnology Academy of Natural Sciences of Philadelphia, Philadelphia, Pa.). 1967. AN ECOSYSTEMATIC STUDY OF THE FAUNA AND FLORA OF THE SAVANNAH RIVER. Proc. Acad. Nat. Sci. Phila., 118(5): 109-407. Appendix.

The number of species in any major group of organisms in a given area did not change greatly from season to season or from year to year. Changes in number of species of insects were correlated with dredging activities in the river. The kinds of species at a station seem to vary greatly from season to season and from year to year in all groups of organisms. Many species occurred only once and only a very few occurred in all studies in a single survey or in the same area over time. The operation of Clark Hill Dam seems to have created more stability in the water level of the river and to have increased the productivity of the river. The lessening of the turbidity of the water in certain seasons has increased the depth of the photosynthetic zone and the algae production in the river proper. This in turn has increased the available food for other organisms. The more stable water level has also produced more stable banks and habitats associated with the banks.

10065. Thomas, Paul M., and Romeo O. Legault. 1967. THE EFFECTS OF INDUSTRIAL WASTES FROM CHARMIN PAPER PRODUCTS COMPANY ON FISH OF THE CHEBOYGAN RIVER DRAINAGE SYSTEM. Water Research, 1(3): 217-229.

This study investigated effects of industrial wastes of a paper mill on fish. Chemical analyses were made of the effluent and of the river water before it entered the mill and at the effluent entry point. Static bioassay techniques were used to determine tolerances to the effluent of ten fish species which were abundant in the paper mill area. Fish were collected from the effluent entry point into the river. An abundant fish fauna was found. Charmin Paper Products Company, Cheboygan, Michigan, treats its waste products thoroughly and is an example of what an industry can do to reduce water pollution. The common shiner, Notropis cornutus, was found to be intolerant to even low concentrations of the effluent. Thus, its presence in an area would indicate a very low level of pollution of this type. (Authors)

10066. Preston, A., D.F. Jefferies, and J.W.R. Dutton (Ministry of Agriculture, Fisheries and Food, Fish. Radiobiol. Lab., Hamilton Dock, Lowestoft, Suffolk, England). 1967. THE CONCENTRATIONS OF CAESIUM-137 AND STRONTIUM-90 IN THE FLESH OF BROWN TROUT TAKEN FROM RIVERS AND LAKES IN THE BRITISH ISLES BETWEEN 1961 AND 1966: THE VARIABLES DETERMINING THE CONCENTRATIONS AND THEIR USE IN RADIOLOGICAL ASSESSMENTS. Water Research, 1(7): 475-496.

Concentrations of caesium-137 and strontium-90 in the flesh of brown trout are reported from two complementary studies: a detailed study over a six-year period of Lake Trawsfynydd (Merioneth, North Wales), comparing quantities of radioactive fallout deposited and water and flesh concentrations for both radionuclides, and general surveys of waters throughout the British Isles. From the British Isles surveys caesium-137 concentrations are related to potassium concentrations in the water and strontium-90 concentrations to calcium concentrations in the water, both as specific activities and as concentration factors, for the whole range of conditions from very dilute calcium bicarbonate surface waters to the marine conditions of coastal waters. It is demonstrated that concentrations of caesium-137 in brown trout flesh from some Scottish waters were probably as high as any recorded from arctic ecosystems. Concentrations of both contaminants in trout flesh can be expressed as functions of water conductivity in calcium bicarbonate surface waters from Britain, and it is suggested that this may be a useful general approach to radiological assessments involving fish from many such surface waters. The radiological implications of the principal conclusions are discussed and simple "risk diagrams" are produced as a guide to the assessment of different situations. It is shown that strontium-90, at or below I.C.R.P. public drinking water concentrations, is unlikely to be a hazard as a result of the human consumption of trout from any area in the British Isles, but that caesium-137 is a potential hazard in some areas down to consumption rates as low as 0.4 g of flesh per day. The results of previous work with these two radionuclides in fresh-water ecosystems are briefly discussed in the context of the studies reported. (Authors)

10067. Brown, V.M., D.G. Shurben, and J.K. Fawell (Water Pollution Research Lab., Stevenage, England). 1967. THE ACUTE TOXICITY OF PHENOL TO RAINBOW TROUT IN SALINE WATERS. Water Research, 1(10): 683-685.

The sensitivity of rainbow trout to phenol in saline waters to which they had been acclimatized increased linearly as salinity increased. At 15° C the 48-hour median lethal concentration (48-hour LC_{50}) decreased from 9.3 mg phenol/l in fresh water to 5.2 mg phenol/l in 60 percent sea water. The response to phenol was quick and concentrations about 1.5 mg/l greater than the 48-hour LC_{50} values could be lethal to fish in an estuary within the period of one tide. The greatest hazard to migrating salmonid fish from the discharge of phenol would appear to exist at the seaward end of their passage. (Authors).

10068. Alabaster, J.S. (Ministry of Agriculture, Fisheries and Food, London, England). 1967. THE SURVIVAL OF SALMON (Salmo salar L.) AND SEA TROUT (S. trutta L.) IN FRESH AND SALINE WATER AT HIGH TEMPERATURES. Water Research, 1(10): 717-730.

The survival of salmon and seatrout smolts, on sudden exposure to increased temperature, has been measured under field and laboratory conditions in both fresh and salt water. Smolts are more sensitive than parr when tested in fresh water, particularly if no special care is taken to acclimate the fish to the test conditions beforehand. Salmon smolts are most sensitive to an increase in temperature when exposed simultaneously to change from fresh to sea water, though the effect is much less even after only 7 hours prior acclimation to sea water; they are most resistant when tested in 30 percent sea water. (Auth.)

10069. Schaumburg, F.D., T.E. Howard, and C.C. Walden (British Columbia Research Council, Vancouver, B.C., Canada). 1967. A METHOD TO EVALUATE THE EFFECTS OF WATER POLLUTANTS ON FISH RESPIRATION. Water Research 1(10): 731-737.

A method is described for direct measurement of variation in the respiratory pattern of salmonids induced by exposure to low concentrations of DDT and kraft pulp mill effluent. The procedure monitors changes in water pressure which occur within the buccal cavity during the passage of water over the gills. A direct relationship was demonstrated between the concentration of toxicant and the frequency of coughing (reversal of water flow over the gills). A significant increase in the rate of coughing occurred at concentrations of DDT and kraft pulp effluent lower than those which cause death in static bioassay. (Authors)

10070. Ball, Ian R. (Water Pollution Research Lab., Stevenage, England). 1967. THE RELATIVE SUSCEPTIBILITIES OF SOME SPECIES OF FRESH-WATER FISH TO POISONS—I. AMMONIA. Water Research, 1(11/12): 767-775.

The acute toxicity of ammonia in a hard, well-aerated water to bream, perch, roach, rudd, and rainbow trout was determined. While trout responded more quickly than the coarse fish so that they were more sensitive over a short period of exposure (1 day), their mortality rate subsequently dropped. The coarse fish, however, continued to die and extension of the test period to the time when the toxicity curves had become asymptotic with the time axis showed that all the species were equally sensitive. The importance of the slope of the concentration response curve in assessing concentrations permissible in the field is discussed. (Auth.)

10071. Ball, Ian R. (Water Pollution Research Lab., Stevenage, England). 1967. THE RELATIVE SUSCEPTIBILITIES OF SOME SPECIES OF FRESH-WATER FISH TO POISONS—II. ZINC. Water Research, 1(11/12): 777-783.

The acute toxicity of zinc in a hard, well-aerated water to rainbow trout, perch, roach, gudgeon, and bream was determined over a period of 7 days. At all times trout were more sensitive than the cyprinid fish, and at the end of the test, perch, roach, and bream showed similar sensitivities. The data confirmed that experiments of short duration are not necessarily reliable for ranking the ultimate sensitivities of several species of fish to a given poison. (Auth.)

10072. Pickering, Quentin H. (Newtown Fish Toxicology Lab. of the Natl. Water Quality Lab, Fed. Wat. Pollut. Contr. Admin., Cincinnati, Ohio). 1968. SOME EFFECTS OF DISSOLVED OXYGEN CONCENTRATIONS UPON THE TOXICITY OF ZINC TO THE BLUEGILL, Lepomis macrochirus, Raf. Water Research, 2(3): 187-194.

Randomized duplicate continuous-flow bioassays were made to determine the effect of three dissolved oxygen concentrations on subacute zinc toxicity to bluegills. The 20-day median tolerance limits (TL_m) at various oxygen concentrations were significantly different at the 95 percent level of confidence, but the effects of zinc concentrations on growth were not significant. (Auth.)

10073. Mount, Donald I. (Natl. Water Quality Lab., Fed. Wat. Pollut. Contr. Admin., Cincinnati, Ohio). 1968. CHRONIC TOXICITY OF COPPER TO FATHEAD MINNOWS (Pimephales promelas, Rafinesque). Water Research, 2(3): 215-223.

Fathead minnows (Pimephales promelas, Rafinesque) were exposed to copper sulfate for 11 months to find the fraction or percentage of the median tolerance limit that does not affect growth and reproduction under prolonged, continuous exposure. Results indicate that the true value lies between approximate limits of 3 and 7 percent of the 96-hour median tolerance limit. The absolute copper concentration that is toxic will depend on certain characteristics of the water but may be estimated using the above percentages of the acutely toxic concentration as determined in the water of concern. (Auth.)

10074. Branson, Branley A. (Dept. of Biology, Eastern Kentucky Univ., Richmond, Ky.). 1967. FISHES OF THE NEOSHO RIVER SYSTEM IN OKLAHOMA. Amer. Midl. Nat., 78(1): 126-154.

On hundred and three species of fishes, or 66% of the species known to occur in Oklahoma, are reported from the Neosho River and its tributaries. Notes on the habitat and habits of the various species, and some theoretical considerations as to how certain species may have entered the system by means of stream-capture from the White River System are included. (Auth.)

10075. Demaree, Richard S., Jr. (Dept. of Life Sciences, Indiana State Univ., Terre Haute, Ind.). 1967. ECOLOGY AND EXTERNAL MORPHOLOGY OF Lernaea cyprinacea. Amer. Midl. Nat., 78(2): 416-427.

The external morphology of Lernaea cyprinacea L. in Vigo Co., Indiana, was more variable than has been previously reported. The pregenital prominence was absent in small lernaeids, then developed as a single protuberance, which doubled as the female copepod lengthened and matured. No correlation was found between the location on the host fish and the direction of torsion. Sixteen species of fishes, taken in Vigo Co., were parasitized by L. cyprinacea. They were: Notropis blennius*, N. atherinoides*, N. spilopterus*, N. volucellus*, Semotilus atromaculatus*, Phenacobius mirabilis*, Hybognathus nuchalis*, Ictiobus niger*, I. cyprinellus*, Lepomis macrochirus, Micropterus salmoides, Pomoxis annularis*, Catostomus commersoni, Esox americanus*, Moxostoma erythrurum*, and Percina maculata* (asterisk denotes new host records). L. cyprinacea parasitized 0.8% of the fishes examined. Usually there was one parasite per fish, attached near a fin. (Auth.)

10076. Harrel, Richard C., Billy J. Davis, and Troy C. Dorris (Dept. of Zoology, Oklahoma State Univ., Stillwater, Okla.). 1967. STREAM ORDER AND SPECIES DIVERSITY OF FISHES IN AN INTERMITTENT OKLAHOMA STREAM. Amer. Midl. Nat., 78(2): 428-436.

The relation between stream order and species diversity of fishes in the Otter Creek drainage basin, a 6th-order intermittent system in north-central Oklahoma, was determined. Fishes were collected after eight months of continuous stream flow and again after a severe drought and two or three days of stream flow. Twenty species of fishes were collected. Species diversity values for both collections were remarkably similar. Species diversity increased progressively with stream order and the correlation coefficient between stream order and species diversity was 0.96. Effects of drought and influx of oil field brines are discussed. (Authors)

10077. Reimers, Paul E., and Robert E. Loeffel (Fish Comm. of Oregon, Research Div., Astoria, Oreg.). 1967. THE LENGTH OF RESIDENCE OF JUVENILE FALL CHINOOK SALMON IN SELECTED COLUMBIA RIVER TRIBUTARIES. Research Briefs, Fish Comm. Oregon, 13(1): 5-19.

Residency of juvenile fall chinook salmon, Oncorhynchus tshawytscha (Walbaum), was studied in 11 Columbia River tributaries below Bonneville Dam. Juveniles were collected and adult and juvenile scales from the Klaskanine River, a tributary with short-term residence, and the Toutle River, a tributary with long-term residence, were compared. Juveniles remained in four larger tributaries at least until sampling during the fall, while seven smaller tributaries were devoid of juveniles by early summer. Disparity of fish size among the tributaries existed and was inversely related to the length of residence. Growth of fish remaining in the tributaries proceeded toward a size of 80-105 mm before migration. Counts of fresh-water circuli on scales of adult and juvenile chinook from the Klaskanine and Toutle Rivers agreed with direct observations of residency. Klaskanine River adults and juveniles averaged 14 fresh-water circuli. Toutle River adults averaged 22 fresh-water circuli, but at last sampling in October the juveniles only averaged 16 circuli. This suggests that Toutle River fish may reside in fresh water until late fall or the following spring. The Toutle River Hatchery has been releasing its fish at small size during their first spring; these fish may be staying in fresh water instead of migrating to the ocean. This practice may limit hatchery contribution to the number of fish needed to achieve stream carrying capacity. The Kalama, Washougal, and North Fork Lewis Rivers may have similar situations. (Authors)

10078. Amend, Donald F., John L. Fryer, and K. S. Pilcher. 1967. A COMPARISON OF OREGON PELLET AND FISH-MEAT DIETS FOR ADMINISTRATION OF SULFAMETHAZINE TO CHINOOK SALMON. Research Briefs, Fish Comm. Oregon, 13(1): 20-24.

The absorption of sulfamethazine by yearling spring chinook salmon (Oncorhynchus tshawytscha) was compared when administered in the Oregon Pellet and a fish-meat diet. The pelleted diet delivered the drug to the fish approximately twice as efficiently as the fish-meat diet. Dosage levels are recommended for both diets, and the efficacy of administering drugs in fish feed is discussed. (Authors)

10079. Pearson, Lincoln S., Kelly R. Conover, and James B. Haas (Fish. Comm. Oregon, Portland, Oreg.). 1967. AN EVALUATION OF ADULT COHO SALMON TRANSPLANTS INTO WILLAMETTE RIVER TRIBUTARIES. Research Briefs, Fish Comm. Oregon, 13(1): 25-38.

Approximately 6,700 adult coho salmon (Oncorhynchus kisutch) from the Fish Commission of Oregon Cascade Hatchery were transplanted to 11 tributaries of the Willamette River in which coho were absent or in low abundance. Surveys were made to evaluate the success of spawning, hatching, and rearing. Fish appeared to spawn successfully in all streams investigated. An average of 33% of the fish released were observed on spawning grounds, and there were 0.67 redds per released female. Most of the fish moved upstream after release and spawning activity was greatest in the general vicinity and above the release sites. Coho fry were observed in five of the seven streams examined. Juveniles were found rearing in the three streams checked in late August and early September. This experimental planting appeared to be successful and should be a useful procedure for establishing runs of coho salmon in new areas. (Authors)

10080. Ingram, Paul G., and Lawrence Korn (Fish. Comm. Oregon, Research Div. Clackamas, Oreg.). 1967. EQUIPMENT AND METHODS FOR STUDYING JUVENILE SALMONIDS IN RESERVOIRS. Research Briefs, Fish Comm. Oregon, 13(1): 39-59.

Equipment and methods for studying juvenile salmonids in reservoirs were evaluated at Pelton, Round Bute, and North Fork reservoirs in Oregon from 1959 to 1966. Oneida Lake traps constructed of 1/4-inch square mesh knotless nylon, and modified to float, effectively caught fish. The traps caught juvenile anadromous salmonids best when water was high and turbid, the traps were clean, and daily

minimum surface water temperatures were below 60° F. Traps were used mainly to capture fish for tagging and to recover tagged fish. Multifilament and monofilament nylon materials were used in gill nets 75 feet long, and only monofilament material was used in nets 60 feet long. Five mesh sizes were used in the 75-foot nets and three mesh sizes in the 60-foot nets. Nylon leadcore line weighted each net. A gill-netting technique, utilizing a portable suspension apparatus that permitted nets to fish at pre-determined distances below the surface of the water, was developed for fluctuating reservoirs. Similarly designated mesh sizes of monofilament and multifilament nylon caught fish of different size compositions. The mean size of coho salmon (Oncorhynchus kisutch) caught in 7/8- and 1-1/8-inch mesh of both materials increased with time. Gill nets were used mainly to obtain information on depth distribution of salmonids. Water clarity and temperature, and the capacity of the air tank were factors which limited SCUBA observations. Divers observed small salmonid fry during day and night, but larger fish were seen mainly at night. Smolt salmonids were difficult to observe during the spring migration period, but some were attracted to a mercury vapor light. A hand net was developed enabling SCUBA divers to capture fish. A portable electric shocker, using direct current and powered by a 12-volt battery, was used occasionally to collect salmonids from reservoirs, but the effort required and results obtained did not justify continuous use. The shocker was used mainly to collect fish from streams above the reservoirs. The shocker was ineffective in large rivers. (Authors)

10081. Mullarkey, William G. (Fish. Comm. of Oregon, Research Div., Elgin, Oreg.). 1967. OBSERVATIONS ON THE LIMNOLOGY OF ROUND BUTTE RESERVOIR, OREGON. Research Briefs, Fish Comm. Oregon, 13(1): 60-86.

The limnology of newly formed Round Butte Reservoir on the Deschutes River in central Oregon was studied from January 1, 1964 through June 30, 1965 as part of a program relating environmental factors to behavior of juvenile anadromous salmonids. The impoundment has three arms formed by the Metolius, Crooked, and Deschutes Rivers which contribute 40%, 40%, and 20%, respectively, of the total flow to the reservoir. Water temperatures ranged between 38° and 75° F. The Metolius River was cooler than the Deschutes and Crooked Rivers throughout the spring and summer. Crooked River water was sometimes identifiable by its high turbidity. Surface water currents appeared to be affected by wind and generally moved up the Metolius Arm and down the Deschutes Arm. Total alkalinity ranged between 33 and 101 ppm, and was lowest in the Metolius River and highest in the Crooked River. Highest alkalinities in the reservoir were at the surface and lowest near the bottom. Dissolved oxygen content was 6.4 ppm or higher in the epilimnion and thermocline; some low concentrations to 0 ppm occurred in the hypolimnion of the Crooked River Arm. The pH ranged from 7.2 to 9.2, and was lowest in the Metolius River and highest in the Crooked River. Diptera were the only zooplankton found and were present during all months of sampling. Small numbers of zooplankton were present in the winter; they increased simultaneously with water temperature during March and April and appeared most numerous in May. Catches in floating traps indicated suckers (Catostomus sp.), rainbow trout and juvenile steelhead (Salmo gairdneri), coho salmon (Oncorhynchus kisutch), and chiselmouth (Acrocheilus alutaceus) were the most abundant species of fish present. Cladocerans, copepods, and Diptera larvae were the most abundant organisms found in the stomachs of coho salmon. The consumption of food organisms was greater in April than any other month. (Auth.)

10082. Hreha, Larry H. (Fish Comm. of Oregon, Research Div., Astoria, Oreg.). 1967. THE RELATIONSHIP BETWEEN SIZE OF JUVENILE COHO SALMON AND THEIR TIME OF EMIGRATION FROM THREE OREGON RESERVOIRS. Research Briefs, Fish Comm. Oregon, 13(1): 87-101.

Juvenile coho salmon (Oncorhynchus kisutch) were captured, tagged, and released in North Fork, Pelton, and Round Butte Reservoirs, and later recovered in the downstream-migrant collection facilities at each dam. Data were analyzed by area, week, and year of tagging. Regression analysis of data from North Fork and Round Butte Reservoirs indicated that once emigration began, large fish remained in the reservoir less time after tagging than small fish. Results at Pelton Reservoir were inconclusive. (Auth.)

10083. Herman, Sidney S., Joseph A. Mihursky, and Andrew J. McErlean (Dept. of Biology and Marine Science Center, Lehigh Univ., Bethlehem, Pa.). 1968. ZOOPLANKTON AND ENVIRONMENTAL CHARACTERISTICS OF THE PATUXENT RIVER ESTUARY 1963-1965. Chesapeake Sci., 9(2): 67-82.

This paper deals with studies on temperature, salinity, turbidity, phosphate, silicate, nitrate, chlorophyll a and zooplankton in the Patuxent River Estuary for a 20-month period from July 1963 to February 1965. Temperatures ranged from less than 1° C to higher than 30° C; salinities ranged from 0.1 to 19.2 $^{o}/_{oo}$ and showed higher values than earlier reported investigations. Turbidities ranged from 0 to 113 ppm and decreased downstream. Phosphates ranged from 0 to 2.1 μg at/L and showed no marked seasonal or distributional patterns. Silicates decreased slightly downstream from a maximum of 135 μg at/L at the uppermost station. Nitrates ranged from 0 to 14.5 μg/L with an early spring maximum and highest values occurred at upstream stations. Chlorophyll a determinations showed minimal winter and maximal spring and summer values; a spring chlorophyll a peak closely followed a spring NO_3 maximum. Zooplankton, sampled with a No. 2 net, showed lowest standing crops during summer and early fall (less than 100/m^3) and highest during winter and early spring (greater than 7000/m^3). By number, copepods comprised 98.1% of total zooplankton (excluding ctenophores and coelenterates). The major components of the zooplankton were Acartia tonsa, A. clausii, Eurytemora affinis. Eurytemora dominated upriver in lower salinities, and A. tonsa, dominated downriver in higher salinities except during March and April, when it was replaced by A. clausii. (Authors)

10084. Tsai, Chu-fa (Univ. of Maryland, Natural Resources Inst., Dept. of Inland Research, College Park, Md.). 1968. EFFECTS OF CHLORINATED SEWAGE EFFLUENTS ON FISHES IN UPPER PATUXENT RIVER, MARYLAND. Chesapeake Sci., 9(2): 83-93.

A 1966 summer survey on fish fauna was made in the upper Patuxent River to evaluate the effect of sewage pollution on fish with respect to species diversity and abundance. Results of this study indicate that chlorinated sewage effluent acts first as a toxic material which seriously reduces fish species diversity and abundance immediately below the effluent outfalls. It also enriches and deoxygenates the water, causing a species shift without affecting species diversity downstream. (Auth.)

10085. Sindermann, Carl J., and George E. Krantz (Bur. of Commercial Fisheries, Biological Lab., Oxford, Md.). 1968. ERYTHROCYTE ANTIGENS AND NATURAL ISOAGGLUTININS OF THE AMERICAN EEL, Anguilla rostrata, FROM CHESAPEAKE BAY. Chesapeake Sci., 9(2): 94-98.

Blood of American eels from Chesapeake Bay was examined with serological techniques. Individual variations in erythrocyte antigens were disclosed by natural isoagglutinins in eel sera and by agglutinins in absorbed rabbit antisera. The complexity of the isoantigen-isoagglutinin system seems to exceed that presently known for any other vertebrate. (Authors)

10086. Kendall, Arthur W., Jr., and Frank J. Schwartz (Univ. of Maryland, Natural Resources Inst., Chesapeake Biological Lab., Solomons, Md.). 1968. LETHAL TEMPERATURE AND SALINITY TOLERANCES OF THE WHITE CATFISH, Ictalurus catus, FROM THE PATUXENT RIVER, MARYLAND. Chesapeake Sci., 9(2): 103-108.

Upper lethal temperatures (LC_{50}, 12 hr) for two size groups (194 and 255 mm mean length) of white catfish acclimated to 20° C were 31.0° C for the smaller fish and 29.2° C for the larger fish. The lethal salinity tolerance (LC_{50}, 60 hr) of this predominantly freshwater fish was 14 $^{o}/_{oo}$. Preliminary data indicate that fish lost 0.4% of their weight per hour in 17 $^{o}/_{oo}$ brackish water. (Authors)

10087. Woolcott, William S., Caperton Beirne, and William M. Hall, Jr. (Dept. of Biology, Univ. of Richmond, Richmond, Va.). 1968. DESCRIPTIVE AND COMPARATIVE OSTEOLOGY OF THE YOUNG OF THREE SPECIES OF FLOUNDERS, GENUS Paralichthys. Chesapeake Sci., 9(2): 109-120.

A comparative skeletal study was made of the young (10-130 mm) of three closely related species of flounders (Paralichthys dentatus, P. lethostigma, and P. albigutta), which occur along the southeastern Atlantic Coast of the United States. The young flounders are difficult to identify unless the pigment pattern is developed, and this usually does not occur in specimens less than 40 mm long. Used in the study were 149 specimens (10-130 mm) of which 122 (10-60 mm) were cleared and stained. External meristic data were collected and skeletal structures compared by observation and measurement. Most of the adult skeletal characteristics had developed in fishes of 50 mm. Osteologically, vertebral and pterygiophore numbers produced the best separation with P. dentatus having the highest counts and P. albigutta the lowest. Total gill rakers on the first gill arch and lateral-line scales were useful characters with the highest numbers occurring in P. dentatus and the lowest in P. albigutta. (Authors)

10088. Smith, David G. (Inst. of Marine Sciences, Univ. of Miami, Coral Gables, Fla.). 1968. THE OCCURRENCE OF LARVAE OF THE AMERICAN EEL, Anguilla rostrata, IN THE STRAITS OF FLORIDA AND NEARBY AREAS. Bull. mar. Sci., 18(2): 280-293.

An account is given of a collection of anguillid eel larvae from the Straits of Florida and nearby waters. Those from the Straits and adjacent Bahamian waters belong exclusively to the American species, Anguilla rostrata (LeSueur). Their occurrence is markedly seasonal, with the smallest individuals appearing in April and the largest in August. They are seldom encountered in the fall and winter, although occasional individuals may be kept at sea beyond the normal duration. A collection of elvers from southern Florida is described. The problem of the dispersal of larval eels from the supposed spawning ground to the areas inhabited by the adults is discussed; insufficient evidence exists at this time to allow any conclusions to be drawn. It is emphasized that much remains to be learned of the life-history of the American eel. (Auth.)

10089. Meeks, Robert L. (Ohio Cooperative Wildlife Research Unit, Columbus, Ohio). 1968. THE ACCUMULATION OF ^{36}CL RING-LABELED DDT IN A FRESHWATER MARSH. J. Wildlife Mgmt., 32(2): 376-398.

An enclosed 4-acre marsh at the southwestern edge of Lake Erie was treated by helicopter with 3.9 millicuries of chlorine-36 ring-labeled DDT at a rate of 0.2 lb technical DDT per acre. Radio-labeled DDT residues were traced until 15 months after the application. Whole body residues were of major concern, although tissues were assayed from vertebrates too large to assay entire. DDT residues were detected in sago pondweed (Potamogeton pectinatus), duckweed (Lemna minor), bladderwort (Utricularia vulgaris), crayfish (Orconectes immunis), tadpoles (Rana pipiens), and carp (Cyprinus carpio) when first assayed 4 hours after the application. The alga Cladophora averaged 96 ppm DDT, or 3,125 times the environmental level, 3 days after the application. A northern water snake (Natrix sipedon) accumulated 36 ppm 13 months after the application. The maximum level in carp was 19 ppm in the soft palate, also after 13 months. Plants and most invertebrates accumulated their highest residues during the first week; vertebrates required longer periods. Algae, the pondweeds (Potamogeton spp.), duckweed, crayfish, and small carp should make good indicator species of environmental DDT residues. (Auth.)

10090. Drury, D.E., and J.G. Eales (Dept. of Biology, Univ. of New Brunswick, Fredericton, N.B., Canada). 1968. THE INFLUENCE OF TEMPERATURE ON HISTOLOGICAL AND RADIOCHEMICAL MEASUREMENTS OF THYROID ACTIVITY IN THE EASTERN BROOK TROUT, Salvelinus fontinalis Mitchell. Canad. J. Zool., 46(1): 1-9.

Histological and radiochemical techniques for assessing thyroid activity were compared on yearling brook trout acclimated at 5°, 12°, and 15° C. The mean thyroid follicle epithelial cell height was 7.4 μ (range 6.0-8.6 μ) at 5° C; 3.5 μ (range 2.9-3.9 μ) at 12° C, and 2.3 μ (range 1.9-2.9 μ) at 15° C. Assuming that a taller epithelial cell height indicates greater thyroid activity, then an inverse

relationship between thyroid activity and acclimation temperature exists. Both the uptake of radioiodide by the thyroid (T/S) and the clearance of radioiodide from the serum were greater at higher temperatures. Serum PB^{125}I production was negligible within 8 days after radioiodide injection and the conversion ratio could not be applied as an index of thyroid function. Assuming, however, that the thyroid radioiodide uptake is an index of thyroid activity, then there is a direct relationship between thyroid activity and acclimation temperature. In view of the marked discrepancy between these histological and radiochemical techniques, fractional rates of turnover of serum thyroxine were compared by determining the biological half-life (t 1/2) for serum PB^{125}I after L-thyroxine-^{125}I intraperitoneal injection at different temperatures. The serum PB^{125}I clearance curves were complex and tentative t 1/2 values of 18.0 days (5° C), 3.2 days (12° C), and 1.5 days (15° C) were obtained. These results indicate a more rapid serum PBI turnover at higher temperatures and support the radiochemical measurements. (Authors)

10091. White, Ray J., and Oscar M. Brynildson. 1967. GUIDELINES FOR MANAGEMENT OF TROUT STREAM HABITAT IN WISCONSIN. Wisconsin Dept. of Natural Resources, Div. of Conservation, Technical Bulletin Number 39. 56 p.

Tailor habitat management to the individual stream. Preserve and restore the natural character of streams and their landscapes. Not only protection but control of stream bank vegetation is often advisable to maintain favorable trout habitat. Overshading is an especially acute hazard along small streams. Meadow creeks with low shrubs and grasses appear to have the best all-around combination of productivity and protection. Remove woody vegetation from banks of small streams where groundwater seepage is adequate to keep summer temperatures moderate. Remove dams and other obstacles to flow (but do not remove meanders). When building in-stream structures, do not impede the current unnecessarily. To aid spawning, protect and enhance naturally occurring stream bed gravel rather than trying to bring in and deposit new gravel. Combat floods by reducing overland runoff back in the drainage basin above the stream, not solely by reinforcing stream banks.

10092. Squire, James L., Jr. (Bur. of Sport Fisheries and Wildlife, Tiburon Marine Lab., Tiburon, Calif.). 1967. SURFACE TEMPERATURE GRADIENTS OBSERVED IN MARINE AREAS RECEIVING WARM WATER DISCHARGES. Bureau of Sport Fisheries and Wildlife Technical Paper 11. 8 p.

10093. Zimmerman, Jerome W. (Bur. of Commercial Fisheries Biological Station, Marquette, Mich.). 1968. WATER QUALITY OF STREAMS TRIBUTARY TO LAKES SUPERIOR AND MICHIGAN. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 559. 41 p.

Water quality of streams tributary to Lakes Superior and Michigan was analyzed for 142 stations on 99 streams tributary to Lake Superior and 83 stations on 56 streams tributary to Lake Michigan during 1962-65. Concentrations of aluminum, copper, and iron were not affected greatly by flow or season. Magnesium, calcium, chlorides, total alkalinity, total hardness, and conductivity varied with the flow, temperature, and season; the lowest values were during the spring runoff and heavy rains, and the highest were during low water in late summer and the colder periods of winter. Concentrations of nitrate, silica, and sulfates were lowest in the spring and summer. Concentrations of tanninlike and ligninlike compounds were highest during the spring runoff and other high-water periods, and were lowest during freezeup when surface runoff was minimal. The pH values were highest from June to September and lowest during the spring runoff. Phenolphthalein alkalinity was detected primarily in the summer and coincided occasionally with low flows just before the spring thaw. Total hardness usually was lower in streams tributary to Lake Superior than in streams tributary to Lake Michigan. The total hardness was higher in the streams in Wisconsin than in the streams in Michigan along the west shore of Lake Michigan. It was lowest in the northernmost streams. The water quality of the streams in an area was related to the geological characteristics of the land. (Auth.)

10094. Smith, Jim Ross, John R. Pugh, and Gerald E. Monan (Bur. of Commercial Fisheries Biological Laboratory, Seattle, Wash.). 1968. HORIZONTAL AND VERTICAL DISTRIBUTION OF JUVENILE SALMONIDS IN UPPER MAYFIELD RESERVOIR, WASHINGTON. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 566. 11 p.

The proposed installation of a fish collecting device in the upper end of Mossyrock Reservoir, soon to be created on the Cowlitz River in southwestern Washington, prompted this study to determine the horizontal and vertical distribution of juvenile salmonids in such an environment. A section of the upper end of Mayfield Reservoir, an existing body of water on the Cowlitz River, was systematically sampled with gill nets and a trawl from April 1964 to June 1965. Eighty-seven percent of the 11,467 salmonids captured were taken in the upper 7.3 m of water, which constituted 52.8 percent of the total sampling area. If the distribution of fish in upper Mossyrock Reservoir is similar to the distribution in Mayfield Reservoir, a collecting device running from shore to shore, extending to a depth of 7.3 m, and designed to collect fish approaching from both the upstream and the downstream sides should collect over 80 percent of all migrating salmonids. (Authors)

10095. Sanford, F. Bruce (Bur. of Commercial Fisheries, Br. of Reports, U.S. Naval Air Station, Seattle, Wash.). 1968. ORGANIZING THE TECHNICAL ARTICLE. U.S. Fish and Wildlife Service, Circular 269. 41 p.

No article can be more efficient than the outline from which it is written. This manual presents a technique for devising an efficient outline by either deductive or inductive reasoning, whichever is more appropriate to the circumstances. The technique is based on strict adherence to the principles of logic. (Auth.)

10096. Nichols, Paul R. (Bur. of Commercial Fisheries Biological Laboratory, Beaufort, N.C.). 1968. PASSAGE CONDITIONS AND COUNTS OF FISH AT THE SNAKE ISLAND FISHWAY, LITTLE FALLS DAM, POTOMAC RIVER, MD. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 565. 14 p.

Resident fish such as sucker, carp, channel catfish, bluegill, and black crappie travelled through the fishway, but apparently no anadromous fish ascended the river far enough to reach the fishway. It is possible that: (1) the runs of anadromous fish are now at such a low level that the spawning area above Little Falls is not needed as in former years; (2) the stocks with the instinct to move above Little Falls which were blocked from their natural spawning ground when the Little Falls Dam was rebuilt in 1949 have since disappeared; and (3) the rapids between Chain Bridge and the fishway may deter the upstream progress of migrating fish. Success in reestablishing runs of anadromous fish above Little Falls may require the planting of fertilized eggs and adult fish in the upper river and the construction of fish-passage facilities at the rapids above Chain Bridge. Successful hatching of shad eggs and the collection of young shad above Little Falls indicate that the river is suitable for the restoration of this species. (Auth.)

10097. U.S. Bureau of Commercial Fisheries. 1968. ANNUAL REPORT OF THE BUREAU OF COMMERCIAL FISHERIES RADIOBIOLOGICAL LABORATORY BEAUFORT, N.C., FOR THE FISCAL YEAR ENDING JUNE 30, 1967. U.S. Fish and Wildlife Service Circular 289. 45 p.

Research activities included studies in estuarine ecology, biogeochemistry, pollution, and radiation effects.

10098. U.S. Bureau of Sport Fisheries and Wildlife. 1967. PROGRESS IN SPORT FISHERY RESEARCH 1966. Bureau of Sport Fisheries and Wildlife Resource Publication 39. 195 p.

10099. Backiel, T., and J. Zawisza. 1968. SYNOPSIS OF BIOLOGICAL DATA ON THE BREAM Abramis brama (L.). Food and Agriculture Organization of the United Nations, FAO Fisheries Synopsis No. 36.

10100. Randall, Clifford W. 1967. POLLUTIONAL ASPECTS OF PESTICIDES IN NATURAL STREAMS. Water Resour. Bull., 3(3): 47-53.

The extensive use of synthetic organic pesticides in this country during the past 25 years has resulted in widespread pollution of our water resources. An obvious detrimental effect of such pollution has been observed in the numerous fish kills that have occurred. The most widely used pesticides, and the ones that have been implicated in the vast majority of the pollutional episodes, are the chlorinated hydrocarbon insecticides. These compounds, generally speaking, have almost no solubility in water, are subject to very slow microbial degradation if any at all, and are so resistent to natural degradation forces they can persist almost indefinitely in aqueous environments; characteristics that are all detrimental from a stream pollution standpoint. In addition, studies have shown that, as a group, the chlorinated hydrocarbons are more toxic to higher forms of aquatic life than other chemicals widely used for pest control. Because of these undesirable characteristics, present trends are to discontinue using these highly toxic, persistent compounds for pest control in outdoor areas. Legislation banning the sale of DDT has been introduced. Similar legislation controlling the use of several of the chlorinated hydrocarbon pesticides is probably the most effective way to reduce pollution. (Auth.)

10101. Poon, Calvin P. C., and Frank J. DeLuise. 1967. MANGANESE CYCLE IN IMPOUNDMENT WATER. Water Resour. Bull., 3(4): 26-35.

Manganese entering impounded water will undergo a cyclic transformation. Oxidation precipitates manganese from top waters. At the bottom of the lake, biological activity will render manganese soluble by both intracellular as well as extracellular activity. The study was made to demonstrate that biological reduction and transformation, organometallic complexation, together with the presence of carbon dioxide and the lowering of pH all have some effect on the solubility of manganese. Dissolved manganese may be brought back to top waters during the lake overturn and therefore deteriorates the water quality. (Authors)

10102. Risebrough, R. W., R. J. Huggett, J. J. Griffin, and E. D. Goldberg (Inst. of Marine Resources, Dept. of Nutritional Sciences, Univ. of California, Berkeley). 1968. PESTICIDES: TRANSATLANTIC MOVEMENTS IN THE NORTHEAST TRADES. Science, 159(3820): 1233-1236.

Concentrations of chlorinated hydrocarbons in airborne dust carried by the trade winds from the European-African land areas to Barbados range from less than 1 to 164 parts per billion. The lower limit of the average content of 1 cubic meter of air is 7.8×10^{-14} gram. The contributions of river-borne and atmospherically transported pesticides to parts of the marine environment are calculated approximately and compared. The amounts of pesticides contributed to the tropical Atlantic by the trade winds appear to be comparable to those carried to the sea by major river systems. (Authors)

10103. Minckley, W. L., and James E. Deacon. 1968. SOUTHWESTERN FISHES AND THE ENIGMA OF "ENDANGERED SPECIES". Science, 159(3822): 1424-1432.

Declines in the populations of native fishes in the American Southwest are largely due to habitat changes associated with man's modification of various aquatic environments. Early decimation of the fauna was mainly a result of large-scale physical change, such as the diversion and impoundment of rivers and downcutting of streams in their formerly stable floodplains. More subtle physical or chemical changes, the lowering of water tables through the use of subsurface water for irrigation, eutrophication and other pollutional effects, and biological phenomena associated with the ever-increasing introduction of exotic species—all are accelerating the extirpation of remnant populations.

10104. Tiemeier, Otto W., and Charles W. Deyoe. 1967. PRODUCTION OF CHANNEL CATFISH. Kansas State Univ. Agricultural Experiment Station Bull. No. 508. 23 p.

10105. Carter, James P. 1968. PRE- AND POST-IMPOUNDMENT SURVEYS ON NOLIN RIVER. Kentucky Fisheries Bulletin No. 48. 28 p.

Investigations were conducted on Nolin River during a 2-year period preceding impoundment, and on Nolin Reservoir the first 4 years of impoundment to determine and evaluate changes in the fish population composition, fishing intensity, creel composition, and fishing success. Monthly water quality studies were performed on the reservoir in 1965 and 1966. Thermal stratification was evident by May both years and a metalimnion persisted throughout the reservoir until late September. In June, oxygen depletion occurred throughout the hypolimnion and lower limit of the metalimnion in the upper two-thirds of the reservoir. Total alkalinity values generally ranged from 80 ppm in late winter to 140 ppm in June. During the summer, concentrations within the metalimnion of the lower two-thirds of the reservoir were generally greater than concentrations either above or below this level. Fish population compositions were determined by sampling with an emulsifiable rotenone formulation at a concentration of 0.5 ppm to 1.0 ppm on the river, and a concentration of 1.0 ppm on the reservoir. Sixty-one species of fishes were recorded from three areas before impoundment and 29 of these were absent from the reservoir studies. The stoneroller was the most abundant species prior to impoundment. After impoundment the samples were numerically dominated by carp (19.4%) and spotted bass (19.0%) in 1963, bluegill (71.2%) in 1964, threadfin shad (80.6%) in 1965, and gizzard shad (71.3%) in 1966. The first year of impoundment the relative abundance of cyprinids decreased 27.4% while centrarchids increased 63.8%. Gizzard shad were collected in the river but were not represented in the reservoir studies until the third year of impoundment; this species may have been precluded from the original fish population of the reservoir by early winter impoundment. The fish population biomass after impoundment fluctuated from 157 pounds per acre in 1963, to 138 pounds per acre in 1964, to 180 pounds per acre in 1965. Carp comprised 47.0% and 53.8% of the biomass respectively the first two years of impoundment and threadfin shad comprised 42.9% the third year. Centrarchids comprised 30.6%, 35.7% and 25.6% respectively the first three years of impoundment. Creel surveys were based on a stratified sampling schedule and the fishing effort was estimated by the mean-count method. The fishing effort increased from an average of 10,260 man-hours before impoundment to 25,336 man-hours (11.5 man-hours per acre), the first year of impoundment. The second year of impoundment the fishing effort was estimated at 39,083 man-hours (16.4 man-hours per acre) and the third year it increased to 58,700 man-hours (31.3 man-hours per acre). The average rate of harvest ranged from 0.16 fish per hour to 0.17 fish per hour before impoundment and from 0.55 fish per hour to 1.13 fish per hour after impoundment. In 1959 the harvest was numerically dominated by black basses (47.9%) and in 1960 it was chiefly comprised of catfishes (29.4%), black basses (26.0%), and sunfishes, (24.0%). After impoundment the harvest was numerically dominated by carp (69.7%) in 1963, sunfishes (54.1%) in 1964, and crappies (58.5%) in 1965. The estimated annual harvest increased from an average of 2,337 pounds before impoundment to 10,641 pounds (4.8 pounds per acre), the first year of impoundment. The second year of impoundment the harvest was estimated at 7,035 pounds (2.9 pounds per acre), and the third year it increased to 10.7 pounds per acre. (Auth.)

10106. Mense, James Burr. 1967. ECOLOGY OF THE MISSISSIPPI SILVERSIDES, Menidia audens Hay, IN LAKE TEXOMA. Okla. Fish. Res. Lab. Bull. No. 6. 32 p.

A study of the life history, distribution, and forage value of the Mississippi silversides, Menidia audens, in Lake Texoma was conducted during 1965 and 1966. Menidia were collected predominantly in the littoral zone; a few were taken in the limnetic zone, but always within 5 feet of the surface. No differences were detected between the night and day catches with the electric shocker and seine, and it appeared that Menidia displayed no diurnal migration to and from the littoral zone. Adult Menidia were never taken after July 31, and thus it appeared that their maximum longevity was about 16 months. Unisexual aggregations of males were found in the littoral zone during April and May, and indirect evidence suggested

that spawning occurred over an extended period of time, beginning in late March and extending through mid-July. Menidia appeared to be an important forage species for piscivorous fishes inhabiting the littoral and surface waters of Lake Texoma. They represented 78% of 290 identifiable fish taken from stomachs of young largemouth bass, Micropterus salmoides, collected in all seasons of the year, and were found in 72% of the stomachs containing identifiable fish. (Auth.)

10107. Williams, Austin B., and Earl E. Deubler (Univ. of North Carolina, Inst. of Marine Sciences, Morehead City, N. C.). 1968. A TEN-YEAR STUDY OF MEROPLANKTON IN NORTH CAROLINA ESTUARIES: ASSESSMENT OF ENVIRONMENTAL FACTORS AND SAMPLING SUCCESS AMONG BOTHID FLOUNDERS AND PENAEID SHRIMPS. Chesapeake Sci., 9(1): 27-41.

Biweekly nighttime samples of macroplankton were collected for a 10-year period (1957-66) from North Carolina estuaries. Establishment of stations, methods of sampling, and hydrographic climates are discussed. Assessment of effects of environmental factors (salinity, temperature, current velocity, wind direction, mechanical clogging of nets, and lunar phase) on sampling success for postlarvae of shrimps (Penaeus) and flounders (Paralichthys) indicates that current velocity and mechanical clogging of nets can have a pronounced effect on sampling success. Evidence is presented which suggests that lunar phase is associated with sampling success for some species, and we postulate that differences in light conditions during new- and full-moon periods may be a causal factor. Variations in temperature, salinity, and wind direction at one station had no discernible effect on size of samples. (Authors)

10108. Williams, Richard B., Marianne B. Murdoch, and Leon K. Thomas (Bur. of Commercial Fisheries Radiobiological Lab., Beaufort, N. C.). 1968. STANDING CROP AND IMPORTANCE OF ZOOPLANKTON IN A SYSTEM OF SHALLOW ESTUARIES. Chesapeake Sci., 9(1): 42-51.

A yearlong study of the general taxonomic composition and standing crop of zooplankton was made in a system of shallow estuaries near Beaufort, N. C. Ten stations were sampled with a No. 10 net at 5-week intervals. Copepods predominated; meroplanktonic larvae were second in importance. Standing crop ranged from 0.002 to 0.46 ml/m^3 (displacement volume). Averages for the stations ranged from 0.089 to 0.149 ml/m^3 and were not significantly different from one another. Averages for the surveys ranged from 0.033 ml/m^3 in in July-August to 0.285 in January. The standing crop was significantly greater in the winter than in the late summer. The annual average, 0.114 ml/m^3, multiplied by the average depth of the estuaries, 1.18 m, yielded a standing crop of 0.13 ml/m^2. Comparison of our data with other studies suggested that a small standing crop of zooplankton was typical of shallow embayments. For areas other than the open sea, standing crop was approximated by the equation:

$$\text{Zooplankton vol. } (ml/m^2) = 0.259 \times \text{avg length water column } (m)^{1.145}$$

Factors responsible for the scarcity of zooplankton in the Beaufort area were not identified, but temperature, food supply, and tidal flushing were eliminated as potential factors. Daily food consumption by zooplankton was estimated to be only 2 to 9% of the phytoplankton net photosynthesis. In shallow areas the importance of zooplankton as a part of the herbivore link in the food chain appeared inversely related to the average length of the water column. (Authors)

10109. Foerster, John W. (Div. of Biological Sciences, Marine Research Laboratories, Noank, Conn.). 1968. A PORTABLE NON-ELECTRICAL CURRENT METER. Chesapeake Sci., 9(1): 52-55.

An inexpensive, non-electrical current measuring device has been developed and tested. It is based on the principle of the Pritchard vane, but is more compact and universally applicable to both marine and fresh shallow water situations. Standardization tests have been performed and the statistics are noted. Emphasis is placed on the portability and ease of handling and reading. One sample table of current velocities obtained by this meter is presented. (Auth.)

10110. Mitrovic, V.V., V.M. Brown, D.G. Shurben, and M.H. Berryman. 1968. SOME PATHOLOGICAL EFFECTS OF SUB-ACUTE AND ACUTE POISONING OF RAINBOW TROUT BY PHENOL IN HARD WATER. Water Research, 2(4): 249-254.

Some pathological changes found in rainbow trout poisoned by phenol concentrations near the 48-hour median lethal concentration are described. Fish killed within a few hours revealed at autopsy gross changes which included inflammation and necrosis of the pharynx and gills, internal hemorrhages, with blood in the body cavity and swelling of the spleen. Extensive, but less severe, damage involving the gall-bladder, liver and kidney, also occurred in fish surviving for 7 days in the lower concentrations used. Gill damage, following the initial inflammatory response, consisted of the stripping of the epithelium from the secondary lamellae, leaving only the naked pillar cells, and from the filament. During these changes the distal parts of the filaments themselves were in some cases destroyed. Fish surviving for 7 days showed changes in the skin, liver, kidney, spleen, small intestine, and ovary. (Authors)

10111. Brown, V.M., V.V. Mitrovic, and G.T.C. Stark. 1968. EFFECTS OF CHRONIC EXPOSURE TO ZINC ON TOXICITY OF A MIXTURE OF DETERGENT AND ZINC. Water Research, 2(4): 255-263.

The toxicity of a soft alkyl benzene sulphonate (ABS) to rainbow trout which had been exposed (100 days) to water containing 0.8 mg Zn/l was compared with its toxicity to untreated control fish. When tested alone, the toxicity of ABS was similar for fish from both treatments but when tested in the presence of 0.8 mg Zn/l the mixture was more toxic to the fish previously exposed to zinc. Although it has been found at this laboratory that fish chronically exposed to zinc acquire resistance to acute poisoning by zinc this does not appear to be so when ABS is present with zinc. The histopathological effects of detergent on the gills were similar to those described for other species of fish and proceeded from swelling and thickening of the gill filaments to final destruction of the epithelial walls of the secondary lamellae and adhesion of the pillar cells. (Authors)

10112. Cordone, Almo J., and Ted C. Frantz (Calif. Dept. Fish and Game, Sacramento, Calif.). 1968. AN EVALUATION OF TROUT PLANTING IN LAKE TAHOE. Calif. Fish and Game, 54(2): 68-89. Illus.

Experimental plants of various strains of rainbow and cutthroat trout (Salmo gairdneri and S. clarki) made in Lake Tahoe from 1960 to 1963 were evaluated for both immediate and long-range contributions to the sport fishery. None of the plants were considered as successful as was desired. Lahontan and Yellowstone cutthroat (S. c. henshawi and S. c. lewisi) contributed least to the fishery. Estimated total harvests of various Kamloops rainbow (S. g. kamloops) plants were never greater than 4%. However, they showed some potential for providing a long-range or premium fishery. Domestic rainbow contributed relatively few premium fish to the creel, but had the highest immediate returns (3 to 36%). The majority of those caught were recaptured within 60 days of release. An occasional Kamloops and domestic rainbow survived in the lake for as long as 3 to 4 years. To demonstrate other characteristics, (e.g., movements, growth, etc.) of trout stocked in Lake Tahoe, returns from plants made over a 9-year period (1956-1964) were used. Kamloops and Williams Lake rainbow (a wild strain from Idaho) distributed themselves widely in Tahoe's limnetic zone, and the Kamloops commonly entered its tributaries. Domestic and Pyramid Lake rainbow (a wild strain from Nevada) tended to remain in the lake in shallow, rocky areas. Initially, planted trout grew at a rate of about 0.4 inch per month and then gradually tapered off to about 0.1 inch per month after 30 months in the lake. The largest premium trout came from plants of domestic rainbow trout. Lack of an adequate food supply, mortality associated with life in the tributaries, and predation of lake trout (Salvelinus namaycush) appear to be the factors most responsible for the poor survival of stocked trout. Put-and-take plants of large (10- to 14-inch) domestic rainbow made from the shore during summer months appear to offer the best means of improving fishing through stocking, particularly for anglers fishing from the shore or from piers. (Authors)

10113. Schafer, William E. (Calif. Dept. Fish and Game, Sacramento, Calif.). 1968. STUDIES ON THE EPIZOOTIOLOGY OF THE MYXOSPORIDAN Ceratomyxa shasta Noble. Calif. Fish and Game, 54(2): 90-99. Illus.

Epizootics of Ceratomyxa devastated stocks of rainbow trout (Salmo gairdneri) at Crystal Lake Hatchery, Calif., in 1948, 1949, 1962, and 1963. Wild rainbow trout, eastern brook trout (Salvelinus fontinalis), brown trout (Salmo trutta), and silver salmon (Oncorhynchus kisutch) were more resistant to the disease. Springs in the area appeared free of the disease but most streams and impoundments examined were infected. Changing the source of the water supply at Crystal Lake Hatchery in 1965 apparently eliminated the disease from this installation. Information is included on distribution of the disease, its seasonal occurrence, symptoms, and transmission, and resistance of various fishes to it. (Auth.)

10114. Schneider, James C. 1965. FURTHER STUDIES ON THE BENTHIC ECOLOGY OF SUGARLOAF LAKE, WASHTENAW COUNTY, MICHIGAN. Pap. Mich. Acad. Sci., Vol. 50, pp. 11-29.

By means of synoptic sampling at 23 uniformly spaced stations certain differences in the kinds, abundance, and distribution of benthic organisms in Sugarloaf Lake between two years (Synoptic I, 1955-56 and Synoptic II, 1957-58) have been detected. Biomass did not differ significantly between the two years. Biomass differed between stations and was positively correlated with the density of the standing crop of vegetation. Stations which were high in biomass one year were also high the second. The numbers and relative abundance of various species varied from station to station and between years. About equal numbers of kinds of organisms were more abundant, less abundant, and about equally abundant in Synoptic II as compared to Synoptic I. The distribution patterns of certain faunal elements changed appreciably whereas others remained essentially the same. Certain data suggest that wind is a factor in the distribution of certain species of bottom organisms. Most of the benthic species were contagiously distributed. Certain species associations have been determined by means of correlation and graphical analyses. (Auth. summ.)

10115. Kempinger, James J. 1968. IMPACT OF UNDERWATER SPEARFISHING ON A MIXED WARMWATER FISH POPULATION. Wisconsin Dept. of Natural Resources Research Report No. 30. 10 p.

During the three-year study, underwater spearfishermen captured fish at the same rate as hook and line fishermen. Vulnerability of the walleye, northern pike, and smallmouth bass to spearfishing was very low. Impact of spearfishing on the Nebish Lake warmwater fish population was negligible. Rock bass were speared in greatest abundance, but during the 1966 season, only 0.4 % of the age I and older rock bass population was exploited. Snorkel and face mask users were approximately two and four times more effective, respectively, capturing fish than participants using SCUBA gear. Hand and spring-operated spears were equally effective. No confliction arose between spearfishermen and anglers during the study period. (Auth. summ.)

10116. Weisbart, Melvin (Dept. of Zoology, Univ. of British Columbia, Vancouver, B.C., Canada). 1968. OSMOTIC AND IONIC REGULATION IN EMBRYOS, ALEVINS, AND FRY OF THE FIVE SPECIES OF PACIFIC SALMON. Canad. J. Zool., 46(3): 385-397.

The physiological basis of the differences in the early life histories of pink (Oncorhynchus gorbuscha), chum (O. keta), coho (O. kisutch), chinook (O. tshawytscha), and sockeye (O. nerka) were examined. The LD_{50} values indicated that the embryos and alevins of the five species are stenohaline; that coho, chinook, and sockeye fry are stenohaline; and that pink and chum fry are euryhaline. However, pink and chum embryos and alevins showed significantly greater salinity resistance and osmoregulatory ability than embryos and alevins of the other species. This ability of pink and chum alevins was correlated with better serum regulation of sodium and chloride. Similarly, pink and chum fry manifested better blood sodium and chloride regulation than coho, chinook, and sockeye fry. Osmotic and

ionic blood concentrations indicated that the greater salinity resistance of chinook alevins and fry over coho and sockeye alevins and fry was due to high tissue tolerance. The five species of embryos and fry, taken as a group, have greater salinity resistance and osmoregulatory ability than the five species of alevins. (Auth.)

10117. Hickman, Cleveland P., Jr. (Dept. of Zoology, Univ. of Alberta, Edmonton, Alberta, Canada). 1968. GLOMERULAR FILTRATION AND URINE FLOW IN THE EURYHALINE SOUTHERN FLOUNDER, Paralichthys lethostigma, IN SEAWATER. Canad. J. Zool., 46(3): 427-437.

The glomerular filtration rate, determined with C-14 inulin, and urine flow rate were studied over a 10-month period in adult female southern flounder, Paralichthys lethostigma. The rate of glomerular filtration was low in winter, varying between 0.005 and 0.68 ml/h x kg body wt. (four fish), and higher in late spring, summer, and early fall, varying between 1.06 and 2.10 ml/h x kg (seven fish). The seasonal change in filtration rate corresponded to the migratory behavior of adults which migrate between a fully marine winter habitat on the continental shelf and a summer habitat in dilute, inshore waters. Urine flow rates varied between 0.11 and 0.85 ml/h x kd in different specimens, and was associated more closely with the solute load excreted than with the filtration rate. Both the glomerular filtration rate and the urine flow may fluctuate appreciably during an experiment. (Auth.)

10118. Hickman, Cleveland P., Jr. (Dept. of Zoology, Univ. of Alberta, Edmonton, Alberta, Canada). 1968. URINE COMPOSITION AND KIDNEY TUBULAR FUNCTION IN SOUTHERN FLOUNDER, Paralichthys lethostigma, IN SEAWATER. Canad. J. Zool., 46(3): 439-455.

Magnesium, sulfate, and chloride make up approximately 80% of the total millimolar concentration of major electrolytes in the urine of southern flounder in seawater. The remaining major electrolytes present are calcium, sodium, potassium, phosphate, and an unknown anion component. As a rule, more sodium was present when urine flow was very low; phosphate concentration was highly variable but its concentration was not associated with urine flow. Urine composition was independent of the glomerular filtration rate. With one exception, the urine osmolality was substantially less than the millimolar concentration, because of the low activities of the divalent ions present and because some of the urine calcium and phosphate precipitated out of solution. The urine was usually 5-15 mosmoles hypoosmotic to the blood; it occasionally became slightly hyperosmotic to the blood for a brief interval after operative procedures. The average percentage filterabilities of the plasma electrolytes, determined by centrifugal ultrafiltration, were Na, 78.4%; Cl, 91.1%; K, 88.0%; Ca, 18.5%; Mg, 54.6%; PO_4, 48.7%. Calculation of the quantities of electrolytes filtered, reabsorbed, secreted, and excreted showed that the urine is primarily a product of tubular secretory activity, but that at high filtration rates the absolute quantities of monovalent ions reabsorbed by the tubular epithelium may greatly exceed the quantities of divalent ions secreted. The divalent ion secretory mechanism was found to respond sensitively and specifically to ion loading produced by $MgCl_2$ infusion or exposure to concentrated seawater. The possible location of specific ion reabsorptive and secretory activities and differences in tubular permeability to water is discussed in relation to the known morphology of the kidney. (Auth.)

10119. Hickman, Cleveland P., Jr. (Dept. of Zoology, Univ. of Alberta, Edmonton, Alberta, Canada). 1968. INGESTION, INTESTINAL ABSORPTION, AND ELIMINATION OF SEAWATER AND SALTS IN THE SOUTHERN FLOUNDER, Paralichthys lethostigma. Canad. J. Zool., 46(3): 457-466.

Simultaneous measurements of flow rates and major electrolyte composition of urine and rectal fluid were made on five southern flounders, Paralichthys lethostigma, averaging 1.19 kg body weight. Rectal fluid is a residue of seawater swallowed by the fish, isosmotic to the blood plasma (336 mosmoles/l), and composed principally of magnesium (average 180 mmoles/l), sulfate (average 105

mmoles/l), and chloride (average 126 mmoles/l). Only 15.5% of the magnesium and 11.3% of the sulfate swallowed was absorbed from the intestine; all absorbed was probably excreted entirely by the kidney. The rate of seawater ingestion calculated from the total (renal + rectal) excretion of magnesium and sulfate yielded estimates averaging 4.6 ml/h x kg body weight. Of this volume, 24% (average 1.1 ml/h x kg) was eliminated as rectal fluid, 4% (average 0.18 ml/h x kg) was excreted as urine and 72% (average 3.3 ml/h x kg) was lost osmotically across the body surface. Nearly 99% of the sodium, 98% of the potassium, and 93% of the chloride swallowed was removed by an extrarenal route, presumably the gills. Of the calcium swallowed, 32% remained in the rectal fluid residue, 8% was excreted in the urine, and the rest (60%) was removed by unknown extrarenal pathways. (Auth.)

10120. Fischer, Hartwig (Depts. of Parasitology and Zoology, Univ. of Toronto, Toronto, Ont., Canada). 1968. THE LIFE CYCLE OF Proteocephalus fluviatilis Bangham (CESTODA) FROM SMALLMOUTH BASS, Micropterus dolomieui Lacépède. Canad. J. Zool., 46(3): 569-579.

In all, 1,176 smallmouth bass (Micropterus dolomieui), ranging from 1.0 to 46.7 cm in fork length, were examined for Proteocephalus fluviatilis Bangham. Of bass more than 7.6 cm in length, 67% were infected whereas 16% of bass fry less than 7.6 cm in length contained these cestodes. Plerocercoids, segmented, and early gravid P. fluviatilis occurred throughout the sampling period from May into October, but egg shedding worms were not found until June when the surface temperature of the lake approached 15° C. Gravid P. fluviatilis were up to three times larger in Ontario than in Ohio. The egg was described, and structures similar to "penetration glands" or "epidermal glands" reported from cyclophyllidean cestodes were found in the oncosphere. Plerocercoids of P. fluviatilis developed in mature female Cyclops bicuspidatus, C. vernalis, C. scutifer, and Tropocyclops prasinus; development from egg to plerocercoid I required approximately 18 to 21 days at 18° C. Plerocercoid I infected smallmouth bass fry directly from the copepod, increased in size to plerocercoid II, then segmented and matured without leaving the gut. Plerocercoids, segmented but not gravid worms, and scoleces from gravid worms were transferred from one bass to another and continued growth and differentiation in the second host. Plerocercoids survived as long as 6 days in fish other than bass, but segmented worms did not survive longer than 24 hours. (Auth.)

10121. Kobayashi, H., and M. A. Ali (Dept. of Biology, Univ. of Montreal, Montreal, Quebec, Canada). 1968. ELECTRORETINOGRAM OF THE SUNFISH (Lepomis gibbosus L.). Canad. J. Zool., 46(3): 605-607.

The electroretinogram (ERG) of the sunfish recorded from the unpunctured eye in situ is of the cone type. It has a-, b-, and d-waves in the light-adapted state. In the dark-adapted fish the response is slower and lacks the c-wave. When stimulus duration is progressively reduced (in the light-adapted state), the b- and d-waves approach each other and fuse at a duration of about 40 msec. The sunfish's ERG resembles, in general, that of the salmon except that it lacks a c-wave and has more prominent waves. (Authors)

10122. Wiebe, John P. (Dept. of Zoology, Univ. of British Columbia, Vancouver, B.C., Canada). 1968. A TECHNIQUE FOR GONADECTOMY IN THE SEAPERCH Cymatogaster aggregata. Canad. J. Zool., 46(3): 613-614.

A technique is described for successful gonadectomy of the seaperch (shiner perch), Cymatogaster aggregata. The operation requires only a very short abdominal incision and has permitted 100% survival of the specimens. (Auth.)

10123. Miller, Daniel J., Melvyn W. Odemar, and Daniel W. Gotshall. 1967. LIFE HISTORY AND CATCH ANALYSIS OF THE BLUE ROCKFISH (Sebastodes mystinus) OFF CENTRAL CALIFORNIA, 1961-1965. Calif. Dept. of Fish and Game, MRO Reference No. 67-14. 130 p.

10124. Rabe, Fred W. (Dept. of Biological Sciences, Univ. of Idaho, Moscow, Idaho). 1968. BROOK TROUT POPULATIONS IN HIGH LAKES. Northwest Sci., 42(1): 20-28.

Populations of brook trout, Salvelinus fontinalis, inhabiting two adjacent alpine lakes were studied over an 8-year period. Size of fish decreased progressively with time in a lake where fish-food biomass was low and production of young was possible. Brook trout from 175-225 mm remained in the same condition over a long period of observation in the experimental lake. The control showed an upward trend in condition of fish from comparable length classes. (Auth.)

10125. Sheridan, W. L., and W. J. McNeil. 1968. SOME EFFECTS OF LOGGING ON TWO SALMON STREAMS IN ALASKA. J. Forestry, 66(2): 128-133.

Sedimentation of spawning beds and density of pink salmon (Oncorhynchus gorbuscha) were observed before and after logging in two streams in southeastern Alaska. The study lasted seven years (1958-1964). Although the amount of fine particles in spawning beds increased temporarily, the amount in 1964 (five years after logging began) was not significantly greater than in 1959. Densities of salmon spawners and fry increased in the sampling areas during the period of this study. The increases were probably due to the abolition in 1959 of salmon traps (formerly the primary means of catching salmon). (Authors)

10126. Deyoe, C. W., and O. W. Tiemeier. 1966. CHANNEL CATFISH FEEDING RESEARCH. Feedstuffs, 38(8): 56.

Excellent growth and survival of fingerling channel catfish were obtained by feeding pelleted feed containing a maximum of 5% animal protein. Calories required to produce a pound of fingerling varied from 881 to 1,075 in four diets. Similar growth and survival data were obtained by feeding age class II fish expanded and pelleted feed of the same formulation. Difference in initial weight of 1 gm in age class II fish resulted in a difference of 3.97 gm in final weight. (Auth. summ.)

10127. Williams, I. V., and P. Gilhousen. 1968. LAMPREY PARASITISM ON FRASER RIVER SOCKEYE AND PINK SALMON DURING 1967. Progr. Rep. int. Pacif. Salm. Fish. Comm. No. 18. 22 p.

The 1967 late season runs of sockeye salmon (Oncorhynchus nerka) to the Fraser River, of which the great majority were bound for Adams River, showed a high incidence of lamprey parasitism. When first examined in the lower Fraser River, 67% of Adams sockeye had been attacked by lampreys (Entosphenus tridentatus) and 6% bore wounds classed as severe. However, blood samples indicated no significant difference in packed blood cell volume between wound severity classes. Later, on the Adams River spawning grounds, many wounds showed signs of healing and comparable percentages for wounded fish were 57% overall, and 5% severe. Mortality of the Adams River run during up-river migration was calculated at less than 2%. Other races of sockeye entering the lower Fraser at the same time as the Adams fish showed a 65% overall incidence of lamprey wounds and a 3% incidence of severely wounded fish. Among pink salmon (O. gorbuscha) examined in the lower Fraser, the incidence of wounded fish was only 20%, and less than 2% carried moderate or severe wounds. Although mortality of sockeye and pink salmon was considered to be negligible during up-river migration, some evidence suggested a possibly greater mortality of fish in Georgia Strait, prior to river entry. (Authors)

10128. Cairns, John, Jr., and Jules J. Loos (Dept. of Limnology, Acad. Natural Sci. Philadelphis, Philadelphia, Pa.). 1967. CHANGED FEEDING RATE OF Brachydanio rerio (Hamilton-Buchanan) RESULTING FROM EXPOSURE TO SUBLETHAL CONCENTRATIONS OF ZINC, POTASSIUM DICHROMATE, AND ALKYL BENZENE SULFONATE DETERGENT. Proc. Pa. Acad. Sci., Vol. 40, pp. 47-52.

Zebra danios, Brachydanio rerio, were exposed to 3.7 and 6.7 ppm Zn^{++}, 56 and 75 ppm $K_2Cr_2O_7$, and 10 and 32 ppm ABS mixture (54.8% active ingredient) under controlled conditions. The time required for each fish to consume 10 out of 20 pieces of tubifex worms was determined at 0, 24, 48, 72, and 96 hours. Although the response of individuals varied markedly, after 96 hours of exposure the majority of exposed fish required more time to consume allotted food than did the majority of the control fish. (Authors)

10129. Bern, Howard A. 1967. HORMONES AND ENDOCRINE GLANDS OF FISHES. Science, 158(3800): 455-462.

The interrenal (adrenocortical) gland is an example of an endocrine structure which shows great morphologic variation in the vertebrate series, and among the fishes themselves. The structural variability implies little selective value for any particular pattern, and, in fact, biochemically the interrenal tissue would seem to be involved in much the same kind of steroidogenesis in the vertebrates generally. However, the hormone aldosterone may be a tetrapod novelty. The caudal neurosecretory system is a good example of a ubiquitous endocrine apparatus, among at least teleostean and elasmobranch fishes, for which a function has yet to be elucidated and which continues to challenge the comparative physiologist. This system, along with the Stannius corpuscles, is lacking in the tetrapods. The existence of these structures makes it clear that the endocrine biology of fishes cannot be tacitly summarized as being essentially similar to that of the tetrapods, only less well developed. The prolactin situation illustrates the existence of a gland—the pituitary —present among fishes as among tetrapods, which secretes a product only partly related to the tetrapod hormone and having a very different functional significance. In this case it is clear that "the hormone and the uses to which it is put" have undergone evolutionary change during vertebrate phylogeny. (Auth. summ.)

10130. Nakamura, Eugene L. 1968. VISUAL ACUITY OF TWO TUNAS, Katsuwonus pelamis AND Euthynnus affinis. Copeia, No. 1, pp. 41-49.

Two tunas, Katsuwonus pelamis and Euthynnus affinis, were trained to discriminate between vertically and horizontally striped images. The striped images were projected on a plate of opal glass which rested against a window of the experimental tank. Visual acuity depended upon the width of the stripes and the distance between the fish and the window at the instant the projector was turned off. The fishes were adapted to an illumination of 170 luxes. At lower luminances of the white stripes, the visual acuities of the two species were similar. At higher luminances of the white stripes, K. pelamis had a greater visual acuity. Maximum visual acuity for K. pelamis was about 0.180 and for E. affinis about 0.135. (Auth.)

10131. Fujino, Kazuo, and Tagay Kang. 1968. SERUM ESTERASE GROUPS OF PACIFIC AND ATLANTIC TUNAS. Copeia, No. 1, pp. 56-63.

Starch-gel electrophoretic analysis of serum specimens of 8,201 skipjack tuna (Katsuwonus pelamis), 187 albacore (Thunnus alalunga), 107 bigeye tuna (T. obesus), and 65 yellowfin tuna (T. albacares) taken from the Pacific and Atlantic oceans demonstrated individual genetic variations in the serum esterase component within each species. The esterase system proved to be independent of any known blood group systems, of sex, and of size of fish in each species. In skipjack tuna extensive data allowed an application of the system to the problem of identifying subpopulations, or isolated breeding populations. Heterogeneity tests for the gene frequencies of the esterase system showed: a) a population in the equatorial Atlantic is different from any populations recognized in the Pacific; b) eastern Pacific (Baja California) specimens were indistinguishable from those of Hawaiian waters; and c) the western Pacific (Japan and Palau) has at least one subpopulation different from the population in Hawaiian waters. (Authors)

10132. Chen, T.R., and A.W. Ebeling. 1968. KARYOLOGICAL EVIDENCE OF FEMALE HETEROGAMETY IN THE MOSQUITOFISH, Gambusia affinis. Copeia, No. 1, pp. 70-75.

In both sexes of the mosquitofish Gambusia affinis, a constant diploid chromosome number of 48 was observed in squashes of gill epithelium, testes, and spleen. The female karyotype invariably includes a single distinctly large metacentric chromosome, absent in all males examined, which strongly indicates female heterogamety of the "WZ" type. The smallest acrocentric, also without a homomorph, probably complements this large W; in the male the smallest pair of similar acrocentrics (ZZ?) forms an atypical meiotic bivalent. The cytological expression of digamety in teleostean fishes is briefly discussed. (Authors)

10133. Hudson, Patrick L., and Bruce C. Cowell (North Central Reservoir Investigations, Bur. of Sport Fisheries and Wildlife, Yankton, S. D.). 1966. DISTRIBUTION AND ABUNDANCE OF PHYTOPLANKTON AND ROTIFERS IN A MAIN STEM MISSOURI RIVER RESERVOIR. Proc. S. D. Acad. Sci., Vol. 45, pp. 84-106.

A study of the distribution and abundance of phytoplankton and rotifers was conducted in Lewis and Clark Lake between November 1963 and November 1964. Samples were collected from 10 stations in the reservoir and with an automatic plankton sampler installed in the powerhouse of Gavins Point Dam to monitor discharges from Lewis and Clark Lake. Numerical mean densities of net phytoplankton and rotifers increased linearly from the headwaters of the reservoir to the face of the dam; phytoplankton increased 3-fold and rotifers 12-fold. Comparisons of the data from sampling in the reservoir with those obtained from the automatic plankton sampler indicated that the latter is sufficient to monitor seasonal changes in Lewis and Clark Lake. Volumetrically, nanoplankton comprised 89.3% of the annual standing crop of phytoplankton, and diatoms were the dominant group in all months except August. Phytoplankton standing crop values were low throughout the year; the maximum was only 2.41 µl/l, but the annual loss from the reservoir was estimated to be more than 9,000 metric tons (wet weight). This may be a significant factor in reservoir limnology since both standing crop and productivity can be affected by water releases. (Authors)

10134. Haen, Peter J., and Fergus J. O'Rourke. 1968. PROTEINS AND HAEMOGLOBINS OF SALMON-TROUT HYBRIDS. Nature, Vol. 217. pp. 65-67.

Hybrids of Atlantic salmon and brown trout were obtained from a small lake near Mullingar, Ireland. The eye lens, muscle and serum proteins and haemoglobins of these hybrids were compared with salmon and trout. Figures show the electrophoretic pattern of the lens, muscle, and serum proteins, and the haemoglobin patterns of the three fish.

10135. Carbery, J. T., and K. L. Strickland. 1968. RESISTANCE OF RAINBOW TROUT TO ULCERATIVE DERMAL NECROSIS. Nature, Vol. 217. pp. 1158.

The results of experiments confirmed previous findings that rainbow trout do not show clinical signs of ulcerative dermal necrosis. Trout do not act as symptomless carriers of the disease.

10136. Willoughby, L. G. 1968. ATLANTIC SALMON DISEASE FUNGUS. Nature, Vol. 217, pp. 872-873.

Observation on the salmon disease were recently carried on in the English Lakes District. Saprolegnia isolates were made from diseased salmon, trout and char. When the isolates were free of bacteria, sterilized hemp seeds were added. When these were removed after 8 hours to dishes of sterile lake water, they grew abundant fringes of the fungus which produced sporangia releasing zoospores, but no oogonia. The hemp seed cultures were kept several weeks and aerial fungal contaminants became established in some cases. Of nine separate isolates four formed oogonia—all in contaminated cultures. Detailed description of the oogonial material is still tentative, but studies thus far suggest that the salmon disease Saprolegnia may prove more closely related to the S. delica-S. diclina complex than to the S. ferax-S. monoica.

10137. Stuart, Mary R., and Hubert T. Fuller. 1968. MYCOLOGICAL ASPECTS OF DISEASED ATLANTIC SALMON. Nature, Vol. 217, pp. 90-92.

An investigation was initiated to establish the role of fungi in the disease termed ulcerative dermal necrosis (UDN) which affects freshwater fish, particularly salmon. Initially the disease becomes apparent as grey-white bruise-like areas on the surface of the fish. These areas then develop fungal growth which is obvious to the naked eye, with subsequent haemorrhagic ulcers usually developing at each site. Investigation shows that many fungi are involved in disease of fish, mostly representatives of the family Saprolegniaceae. As part of the investigation the general mycoflora of healthy and diseased fish was surveyed. Since 1966, some

90 salmon (Salmo salar), smolts and adults and a more limited number of brown trout (Salmo trutta), fry and adults, have been examined in detail. The fungi most commonly isolated from the surface of healthy and diseased fish, apart from lesions, include species of Penicillium, Fusarium, Mucor and Trichoderma, together with numerous pycnidial fungi, yeasts and unidentified imperfect types. Saprolegnia alone has been isolated constantly from the lesions of diseased fish. Of all the saprolegniacious fungi known to attack fish, Saprolegnia parasitica is the one most frequently reported as a fish parasite. The spread of the disease is most marked during periods of low water temperature and, conversely, with increasing water temperatures there seems to be a diminution of the disease. It was found that Saprolegnia parasitica has a high salinity tolerance. Inoculation experiments now in progress are expected to furnish definitive information about the role of Saprolegnia in ulcerative dermal necrosis. Existing evidence suggests that the fungus is the primary parasite in ulcerative dermal necrosis or alternatively that an extremely close relationship exists between an unknown primary parasite and Saprolegnia.

10138. Hubbs, Clark. 1967. GEOGRAPHIC VARIATIONS IN SURVIVAL OF HYBRIDS BETWEEN ETHEOSTOMATINE FISHES. Bull. Tex. mem. Mus., No. 13. pp. 5-72.

Comparative analyses of more than 500,000 darter eggs variously tested for fertility and viability from 1954 to 1965, and gathered from widely separated geographic locations, showed that darter hybrids were as viable as or more viable than the controls. Both reciprocals of 70 hybrid combinations were reared and more than 60 additional combinations had one reciprocal reared. Eggs were able to inhibit the activity of heterospecific sperm, especially after it had expended about one half its normal activity period; an inhibition obviously designed to reduce the effect of chance meeting of gametes in the water. Several patterns of differential survival were noted, all associated with decreased hybridization potential in sympatry. Included were the first example of postmating reinforcement of isolation mechanisms, and an example of reinforcement being masked by more significant behavioral isolation. Several hybrid combinations had more viable hybrids in one reciprocal than in the other, always occurring where one parent had a high laboratory survival and the other was difficult to rear. All examples were maternally influenced. Relative fecundity studies show that the darters in areas with many species have more and smaller eggs than equal sized females in the peripheral areas where few darter species occur. (Auth.)

10139. Wheeler, Sessions S. 1967. THE DESERT LAKE. THE STORY OF NEVADA'S PYRAMID LAKE. The Caxton Printers, Ltd., Caldwell, Idaho. 133 p. Illus. Pr. $1.95.

The early history of the lake and its trout fishery. Dams and irrigation canals, not commercial fishing in the lake, brought extinction of the Pyramid Lake cutthroat trout. Derby Dam was completed in 1905 across the Truckee River as part of the Newlands reclamation project. It diverted much of the flow from the Pyramid Lake Basin and the water level of the lake dropped. This exposed sandbars at the mouth of the Truckee which combined with lower river flows, eliminated the spawning migration. Although the 41-pound Lahontan cutthroat trout taken in 1925 is listed as the world record, it is reported that a trout weighing 62 pounds was taken in 1916. In 1949 Nevada fisheries personnel took 39 Lahontan cutthroats from Walker Lake and the progeny of these are now used to stock both Pyramid and Walker lakes. In the 1920's fertilized eggs taken at the mouth of the Truckee River were shipped to several hatcheries and it is possible that some lakes now contain true Pyramid Lake cutthroat. Stocked trout are now thriving in the alkaline and saline waters of Pyramid Lake. At its present rate of desiccation it has been estimated that the lake should be suitable for fish for another 75 to 100 years.

10140. Varley, Margaret E. 1967. BRITISH FRESHWATER FISHES. FACTORS AFFECTING THEIR DISTRIBUTION. Fishing News (Books) Limited, 110 Fleet St., London, E. C. 4, England. 148 p.

10141. Ambrosius, H., and W. Schäker. 1964. CONTRIBUTION TO THE IMMUNOBIOLOGY OF POIKILOTHERMIC VERTEBRATES. I. IMMUNOLOGIC INVESTIGATIONS ON CARP. Zool. Jb. Physiol. Bd. 71, S. 73-88.

Experiments were made with 2-year-old carp weighing 500 g at two temperatures of 11° and 20° C ± 1° C. Inactivated swine serum as antigen was used. Fish were immunized by 1 to 5 intramuscular injections of 1 or 2 ml of serum, 1 to 2 days apart. Carp sera were obtained by repeated heart punctures, up to 22 times, with total blood removed from fish up to 22 ml. Inactivated sera were preserved by merthiolate 1:10,000 and stored at -18° C. Immune reactions used (hemagglutination methods of Boyden, 1951 or Stavitsky and Arquilla, 1955) for titration were carried out with sheep erythrocytes treated with tannic acid to which antigen was adsorbed. Immune bodies could be detected in immunized carp at 11° C in 60 - 80 days and at 20° C at 20 to 40 days. Carp maintained high titre antibodies for several months; titre was higher in carp maintained at 20° C. Second immunization, 14 weeks after the first, resulted in increased titre and shorter immunization period. Carp immunized with 2 ml of serum antigen containing 140 mg of protein produced within half a year, 85 to 150 mg of antibody protein. Carp immune sera are as specific as rabbit immune sera. Presence of gamma globulin in carp serum was immunologically confirmed. --S. F. Snieszko.

10142. Ambrosius, H., and R. Lehmann. 1965. CONTRIBUTIONS TO IMMUNOBIOLOGY OF POIKILOTHERMIC VERTEBRATES. III. EFFECT OF ADJUVANTS ON PRODUCTION OF ANTIBODIES IN TELEOST FISHES. Acta biol. med. german., Band 14, Seite 830-844.

Two-year-old carp, (Cyprinus carpio) and brown bullhead (Ictalurus nebulosus) weighing 500 or 300 g, respectively, were used. Methods were the same as in the paper by Ambrosius and Schäker (1964). Under all experimental conditions and at two temperatures (12° and 18° - 20° C). Freunds adjuvant produced faster immunologic response, higher titre and larger quantity of immune protein. Protein precipitated with aluminum hydroxide was better than native protein as antigen but Freund's adjuvant was superior. Use of Freund's adjuvant in immunization of fish at lower temperatures helped to compensate for the slower immune response. There was no basic difference in immune response between a warm-blooded vertebrate (rabbit) and fish (carp and bullhead). --S. F. Snieszko.

10143. Werner, A.E., and M. Waldichuk (Fish. Res. Bd. Canada, Biological Station, Nanaimo, B.C., Canada). 1961. DECAY OF HEXACHLOROCYCLOHEXANE IN SEA WATER. J. Fish. Res. Bd. Canada, 18(2): 287-289.

Hexachlorocyclohexane (HCH) , more popularly known as benzene hexachloride, has received considerable attention in recent years as an insecticide. In a study of some of the effects of this insecticide on freshwater and marine fishes, chemical research was instigated to explore its behavior in sea water. Experiments with Millipore-filtered (i.e., nearly sterile) and unfiltered sea water indicate that the reaction is a chemical one and not dependent on the presence of marine organisms. A comparison of the decay curves for γ-HCH in 50% sea water + 50% distilled water, and in pure sea water, shows that the reaction rate is higher in the latter. Samples of the reaction mixture showed that even after 12 months of storage (at 20° C) a relatively high apparent γ-HCH concentration remained. It is not possible at present to decide if this is a consequence of stable end products of residual γ-HCH.

10144. Bachop, William. 1968. AN OPERATIONAL DEFINITION OF THE TERM "PERIBLAST" FOR THE MUSKELLUNGE EMBRYO (CLUPEIFORMES: ESOCIDAE). Trans. Amer. micr. Soc., 87(1): 120.

Certain operations of anatomical microtechnique and light microscopy make manifest the fact that in the muskellunge (from zygote to hatching), there is one, and only one, acellular protoplasmic layer appressed to the yolk surface. These operations constitute an operational definition of whatever term is chosen to designate this acellular protoplasmic layer. The term chosen is "periblast". The protoplasmic disc containing the zygote nucleus is continuous with the thin protoplasmic layer (periblast) appressed to any yolk surface not overlain by the

protoplasmic disc. At the four-cell stage, the blastomeres are continuous, near the yolk, with each other, and with the thin acellular protoplasmic layer (periblast) still overlying the remainder of the yolk surface. Continued segmentation of the protoplasmic disc results in a mound of blastomeres separated from the yolk by a thicker region (thick periblast) of the continuous acellular protoplasmic layer (periblast) whose thinner region (thin periblast) still overlies the remainder of the yolk surface. Transformation of the acellular protoplasmic layer (periblast) from the thin condition (thin periblast) to the thickened condition (thick periblast) occurs not by simultaneous thickening everywhere, but by consecutive localized thickening of the thin periblast where its protoplasm is continuous with that of the newly thickened periblast. Concurrent with thickening of thin periblast, there occurs nucleation of that thin periblast which is thickening or on the verge of thickening. Giant nuclei occur in the thick periblast, in the zone of thickening, and, infrequently, in the thin periblast contiguous to, and continuous with, the zone of thickening. (Auth.)

10145. Hoffman, G. L., S. F. Snieszko, and Ken Wolf (Bur. of Sport Fisheries and Wildlife, Eastern Fish Disease Lab., Leetown (Kearneysville), W. Va.). 1968. APPROVED PROCEDURE FOR DETERMINING ABSENCE OF VIRAL HEMORRHAGIC SEPTICEMIA AND WHIRLING DISEASE IN CERTAIN FISH AND FISH PRODUCTS. Bureau of Sport Fisheries and Wildlife Fish Disease Leaflet No. 9. 7 p.

United States regulations effective July 1, 1968 require that salmonids and salmonid eggs be certified free from the infective organisms of viral hemorrhagic septicemia and whirling disease before they may be imported into the United States. The purpose of this paper is to describe methods that are acceptable for this certification.

10146. Buhler, Donald R., and Mary E. Rasmusson (Bur. of Sport Fisheries and Wildlife, Fish-Pesticide Research Lab., Columbia, Mo.). 1968. REDUCTION OF p-NITROBENZOIC ACID BY FISHES. Arch. Biochem., 103: 582-595.

A system which catalyzes the reduction of p-nitrobenzoic acid to p-aminobenzoic acid has been found in a number of freshwater fishes. The nitro reductase system occurred primarily in the liver, where it was associated with the soluble fraction of the cell. Fish liver nitro reductase required NADPH and was inhibited by oxygen. Preincubation of the system in air caused a loss of nitro reductase activity, suggesting that some sensitive component of the system had undergone oxidation. Some evidence was advanced relating this inactivation with the formation of lipid peroxides. Various sulfhydryl compounds and chelating agents could reverse or prevent the oxygen-derived inactivation. Additional evidence indicated that the fish liver nitro reductase system contained essential sulfhydryl groups and a carbon monoxide-sensitive component. (Authors)

10147. Wedemeyer, Gary (Bur. of Sport Fisheries and Wildlife, Fish-Pesticide Research Lab., Columbia, Mo.). 1968. ROLE OF INTESTINAL MICROFLORA IN THE DEGRADATION OF DDT BY RAINBOW TROUT (Salmo gairdneri). Life Sciences, 7(3): 219-223.

Though liver homogenates show apparent microsomal enzyme DDT-dehydrochlorinase activity, in the intact fish the intestinal microflora play a major role in DDT detoxication. Since the presence of this microflora in fish depends on the recent intake of food, the rate of detoxication and hence the toxicity of ingested DDT to the rainbow trout will probably depend somewhat on the available food supply. (Auth. summ.)

10148. Buhler, Donald R., and Mary E. Rasmusson (Bur. of Sport Fisheries and Wildlife, Fish-Pesticide Research Lab., Columbia, Mo.). 1968. THE OXIDATION OF DRUGS BY FISHES. Comp. Biochem. Physiol., Vol. 25, pp. 223-239.

Fish liver microsomal systems have been found to catalyze the hydroxylation of aniline and acetanilide, the N-demethylation of aminopyrine and the O-dealkylation of phenacetin. These systems are similar to the corresponding mammalian enzymes and they may be considered to be mixed function oxidases since they

require NADPH and oxygen. An absolute requirement for oxygen, however, was difficult to demonstrate for the hepatic phenacetin cleavage system from fish. Microsomal drug metabolizing systems from fish have temperature optima which are considerably lower than those of corresponding mammalian systems. (Authors)

10149. Kearn, G. C. (School of Biological Sciences, Univ. of East Anglia, Norwich, England). 1968. THE DEVELOPMENT OF THE ADHESIVE ORGANS OF SOME DIPLECTANID, TETRAONCHID AND DACTYLOGYRID GILL PARASITES (MONOGENEA). Parasitology, 58(Pt. 1): 149-163.

The adhesive organs of diplectanid, tetraonchid and dactylogyrid monogeneans develop in very similar ways indicating that all these gill parasites are closely related to each other. The oncomiracidia make initial contact with the general body skin or the lining of the buccal cavity to which they attach themselves by 14 or 16 ventrally orientated marginal hooklets. The growing parasites then find their way to the gills which call for a different kind of adhesive apparatus. In order to anchor itself between two of the host's secondary gill lamellae, two pairs of the parasite's marginal hooklets migrate to the dorsal surface of the haptor and two of the four developing hamuli rotate so that they also point dorsally. In diplectanids the hamuli are assisted by accessory friction pads (squamodiscs) which develop on the surface of the body anterior to the hooks. In dactylogyrids the ventral hamuli do not develop and are represented in the adult only by small spicules. In contrast the marginal hooklets grow during larval development and become important adult attachment organs, together with the dorsal hamuli. Adults of Tetraonchus monenteron feed on the epidermis covering the gills. (Auth. summ.)

10150. Idyll, Clarence P. 1968. THE INCREDIBLE SALMON. National Geographic, 134(2): 194-219.

A well-illustrated account of the life history of the Atlantic and Pacific salmons. Briefly discusses some of the theories of salmon navigation. Concludes with current thinking on the best means of managing and conserving the remaining salmon resources.

10151. Cerini, C. P., and R. G. Malsberger (Lehigh Univ., Bethlehem, Pa.). 1965. MORPHOLOGY OF INFECTIOUS PANCREATIC NECROSIS VIRUS. In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N. Y. Acad. Sci., 126(Art. 1): 315-319.

Tissue culture harvests of infectious pancreatic necrosis virus grown on RTG-2 cells were concentrated by high speed centrifugation. Pellets were suspended in ammonium acetate or water, negative stained with phosphotungstic acid and examined in the electron microscope. Hexagonal particles with a mean dimension of 18.5 mμ were observed in the virus preparations but not in the controls. Capsomeres were not sufficiently resolved for accurate counting but a solution of twelve capsomeres is suggested. (Authors)

10152. Malsberger, R. G., and C. P. Cerini (Lehigh Univ., Bethlehem, Pa.). 1965. MULTIPLICATION OF INFECTIOUS PANCREATIC NECROSIS VIRUS. In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N. Y. Acad. Sci., 126(Art. 1): 320-327.

Multiplication curves of infectious pancreatic necrosis virus at 15° and 24° C were presented. Intra cellular or cell associated virus (CAV) and free virus in the medium were assayed following infection at varying multiplicities. The results indicate that IPN matures intracellularly and not at the cell surface, that the maturation rate is the same as the rate of protein synthesis at both temperatures, and that "shortened latency" occurs at high multiplicities of infection. Some aspects of the failure of IPN to multiply at 4° C will be discussed. The effects of a number of metabolic inhibitors on IPN multiplication will be presented to confirm the type of nucleic acid present. (Authors)

10153. Moewus-Kobb, Liselotte (Univ. of Miami School of Medicine, Coral Gables, Fla.). 1965. STUDIES WITH INFECTIOUS PANCREATIC NECROSIS (IPN) VIRUS IN MARINE HOSTS. In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N.Y. Acad. Sci., 126(Art. 1): 328-342.

Two problems have been under investigation: (a) can a virus of fresh water fish - IPN - infect marine host fish, and (b) can a parasitic vector effect transmission of virus in the sea? Host range studies were carried out by in vivo and in vitro experiments. Infectious virus could be recovered from organ extracts of seahorses 34 days after injection, but continuous passage through these animals was not successful. More refined tests with embryonic seahorse tissue cultures revealed that IPN virus did not multiply in these cells. Experiments with young grunts (Haemulon sciurus) showed that the virus introduced in low concentration (100 TCD_{50}) persisted for 22 days. In addition, cultures of the established line of grunt fin cells yielded an increase of four logs of virus, although the cytopathogenic changes were not regular or consistent. Under agar this virus produced distinct plaques on grunt cell monolayers. Transmission of IPN virus to marine hosts was attempted with a parasitic marine ciliate, Miamensis avidus, n. g. n. sp. This protozoan was grown in two in vitro systems, fish tissue culture cells and a semi-defined, axenic growth medium. Experimental parasitization of seahorses with Miamensis avidus was successful. Injections of small numbers of ciliates (1-10) were found to be lethal. Extensive studies were necessary in order to demonstrate the association of IPN virus with the ciliate cell. Incorporation was achieved either by feeding IPN-infected fish tissue cultures to the parasite or by suspending virus in the axenic growth medium. The virus had no obvious deleterious effect on the ciliates which continued to grow after "infection". Small increments of virus were detected in actively growing populations of ciliates. Inoculation of "infected" ciliates into seahorses demonstrated transmission of virus. It was not determined, however, whether the virus was associated with the ciliates externally or internally. (Auth.)

10154. Clem, L.W., M.M. Sigel, and R.R. Friis (Univ. of Miami School of Medicine, Coral Gables, Fla.). 1965. AN ORPHAN VIRUS ISOLATED IN MARINE FISH CELL TISSUE CULTURE. In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N.Y. Acad. Sci., 126(Art. 1): 343-361.

A virus-like agent, tentatively referred to as the grunt fin agent (GFA), was isolated from a spontaneously deteriorating culture of an established line of grunt, Haemulon sciurus, fin cells in 65th subculture. This agent failed to grow in bacteriological or tissue culture media or in embryonated chicken eggs. No signs of infection were noted in newborn mice inoculated intracerebrally. Efforts to infect live adult grunts were unsuccessful as were attempts at in vitro cultivation in human cancer (HeLa and KB), primary monkey kidney, rainbow trout gonad, and primary goldfish fin cells. The agent replicated with cell destruction in established grunt and goldfish fin as well as primary grunt fin, ovary and liver cells. Replication studies in the established line of grunt fin cells indicated the presence of an eclipse with a latent period of 8-12 hours. Infectivity titers of $10^{6.5}$ $TCID_{50}$/ml were obtained in these cells but no inclusion bodies resultant from infection were evident. Plaque assay of this agent on grunt fin cells under a methylcellulose overlay was successful. Preliminary studies indicated a lack of hemagglutinating activity for human, guinea pig and various fish erythrocytes. Antigenicity, detected by the production of neutralizing antibody, was eatablished in rabbits and in fish but not in guinea pigs. The agent passed a 0.22 μ millipore filter and exhibited a marked temperature lability and ether sensitivity. (Authors)

10155. Weissenberg, Richard. 1965. FIFTY YEARS OF RESEARCH ON THE LYMPHOCYSTIS VIRUS DISEASE OF FISHES (1914 - 1964). In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N.Y. Acad. Sci., 126(Art.1): 362-374.

The lymphocystis disease is characterized by the development of tumors in the connective tissue of the skin. They consist chiefly of large uninucleate cells which in the European flounder, can reach almost 2,000 μ in cell diameter. The disease was known in European flatfishes already at the end of the past century. The

gigantic cells surrounded by a hyaline capsule were interpreted as egg cells of indeterminate parasites of the fishes. Later in 1904, they were described as the parasitic protozoon Lymphocystis johnstonei. Fifty years ago I discovered and investigated the disease in the European perch Acerina cernua. Infectiousness of the disease became soon evident. I found that the large cells are not cells of parasites. They represent metamorphosed fibroblasts of the fish, hypertrophied apparently under the stimulus of intracellular microorganisms. I could find no protozoa or protophyta in the hypertrophying cells, but their cytoplasm contained a conspicuous basophilic network which developed from a small disk reminding me of a Guarnieri body in cells infected by the Vaccinia virus. On this basis, deriving the network from a viral inclusion body, I established the virus theory of the lymphocystis disease in 1914. That interpretation became accepted in Germany and England and later also in the United States. In 1949, I succeeded with osmium staining methods to demonstrate osmiophilic granules in the surface layer of the inclusions and interpreted the granules as elementary bodies of the lymphocystis virus. Finally, in 1962, the virus theory of the disease became definitely proved by the experimental work of Ken Wolf on centrarchids and in electron-microscopic study of the osmiophilic granules by Roland Walker. (Auth.)

10156. Walker, R., and R. Weissenberg (Rensselaer Polytechnic Inst., Troy, N.Y.). 1965. CONFORMITY OF LIGHT- AND ELECTRON-MICROSCOPIC STUDIES ON VIRUS PARTICLE DISTRIBUTION IN LYMPHOCYSTIS TUMOR CELLS OF FISHES. In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N.Y. Acad. Sci., 126(Art. 1): 375-385.

In the virus-induced hypertrophied host cells in lymphocystis disease, the cytoplasm shows a Feulgen-positive inclusion body or network. At the surface of these inclusions in Stizostedion, Pleuronectes, and others, Weissenberg demonstrated osmiophil granules which he interpreted as elementary bodies of the causative virus. Walker's electron microscopy of Stizostedion lymphocystis cells showed hexagonal osmiophil profiles, 200 mμ in diameter, representing icosahedral viral capsids containing osmiophil nucleoids. However, the relation of the virus particles to inclusion substance was not well shown. Electron microscopy after Palade fixation, or with secondary osmification after other fixatives, especially also in Weissenberg's earlier material, now clearly shows that the icosahedral particles do correspond in topography to the osmiophil granules of light microscopy. The 200 mμ mature virus particles of Stizostedion are related to the surface of the inclusion body, especially in smaller cells (as in Lepomis, Walker and Wolf). In larger cells, with a fine-meshed inclusion network, virus particles are more scattered. In Pleuronectes the osmiophil particles are smaller, ca. 150 mμ, but their location and hexagonal profiles are like those of Stizostedion. The electron microscope sometimes shows, as in Weissenberg's reports, paler granules of comparable shape and size between the darkly osmiophil virus particles and the core of the inclusion body. The possible role of these paler structures as developmental stages will be discussed. However, Stizostedion shows an alternate ultrastructure (as in Lepomis) which might be interpreted as virus development: segmentally incomplete (half-formed?) empty osmiophil capsids at the boundary between inclusion and cytoplasm. Cichlasoma lymphocystis cells also have 200 mμ icosahedral virus particles. These may form numerous crystalline arrays at some distance from inclusions, as in Lepomis. Such crystals are rare in Stizostedion and Pleuronectes. (Authors)

10157. Walker, Roland (Rensselaer Polytechnia Inst., Troy, N.Y.). 1965. VIRAL DNA AND CYTOPLASMIC RNA IN LYMPHOCYSTIS CELLS OF FISH. In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N.Y. Acad. Sci., 126(Art. 1): 386-395.

Nucleic acid distribution was studied in mature (300-700 μ) lymphocystis cells of Stizostedion by ultraviolet fluorescence microscopy after acridine orange staining. These cells have large nuclei, large nucleoli, and a fine network of basophil inclusion substance in the cytoplasm. Chromosomes and cytoplasmic inclusions show yellow-green fluorescence after AO stain at pH 5, but not after DNase treatment. This confirms the Feulgen reaction, indicating that DNA is a major com-

ponent of the inclusions. Electron microscopy shows that mature virus particles do not form the main inclusion substance, but are at its surface or scattered elsewhere. The inclusion substance is interpreted as the replicating pool of viral DNA (or DN-protein). Nucleoli show bright orange fluorescence, indicating the presence of RNA. After RNase pretreatment the color becomes yellow-green, as though nucleoli have considerable DNA. Cytoplasmic RNA is wide-spread; with AO fluorescence it is darker orange than the nucleoli, and it is quickly removed by RNase. This RNA forms large masses near the nucleus, and smaller flecks between meshes of the inclusion substance. These may be concerned with synthesis of protein for the virus capsids. In mature Stizostedion lymphocystis cells virus particles are too scattered to allow good staining for light microscopy. In mature Lepomis cells, however, virus particles are massed in a central region away from the inclusions, and here the color of the mass (either with Feulgen stain, or by AO fluorescence) might represent DNA obscured by capsid protein. Observation of the distribution of nucleic acids gives neither proof nor expectation that the viral DNA has been related to nuclear DNA. RNA topography may possibly represent a developmental sequence from nucleoli to perinuclear zone to peripheral areas; however, there is no evidence of passage through the nuclear membrane. (Auth.)

10158. Weissenberg, R. 1965. MORPHOLOGICAL STUDIES ON THE LYMPHOCYSTIS TUMOR CELLS OF A CICHLID FROM GUATEMALA, Cichlasoma synspilum Hubbs. In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N.Y. Acad. Sci., 126(Art. 1): 396-413.

Six classes of size of the hypertrophying Cichlasoma lymphocystis tumor cells from about 15 to 250 μ diameter have been investigated. In the cytoplasm of young cells, small basophilic corpuscles are scattered. In contrast to the rapidly growing Guarnieri body-like Anlagen of the inclusions of perch and flounder tumor cells, such corpuscles give the impression of rudimentary structures. At early stages of the tumor cells, vacuoles appear in their cytoplasm. Osmium preparations show that the cytoplasmic wall of the vacuoles is the first place where an accumulation of small groups of osmiophilic granules, filaments and sometimes paired rods can be seen. In cells of about 50 μ diameter, osmiophilic structures have appeared also in peripheral regions of the cytoplasm. They are often arranged as rings of granules around fields containing rods in the center. The osmiophilic structures in the vacuole wall have now increased in number to clusters which in hematoxylinstained preparations appear as delicate slightly basophilic inclusion bodies. In a few cells of larger size, intensively basophilic inclusion bodies resembling those of other fish groups were observed. Between the cytoplasm of such cells and the cell capsule a space indicating shrinkage of the cytoplasm was conspicuous. In cells of the common size of 115 - 175 μ diameter, accumulation of osmiophilic granules in the central part of the cytoplasm has been observed. Electronmicroscopic investigation by Roland Walker has shown that the granules are polyhedra with hexagonal profiles resembling lymphocystis virus particles observed by Walker in Stizostedion. In the largest cells, the inclusion bodies are seen arranged in a superficial layer beneath the cell capsule. The most remarkable deviation from the usual features of lymphocystis tumor cells consists in the appearance of the osmiophilic structures in the cytoplasmic wall of the vacuoles. (Auth.)

10159. Wolf, K., and C.P. Carlson (Bur. of Sport Fisheries and Wildlife, Eastern Fish Disease Lab., Kearneysville, W.Va.). 1965. MULTIPLICATION OF LYMPHOCYSTIS VIRUS IN THE BLUEGILL (Lepomis macrochirus). In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N.Y. Acad. Sci., 126(Art. 1): 414-419.

Small bluegills which were free of ectoparasites were inoculated subdermally with 34 ID_{50} lymphocystis virus and held at 25° C. Immediately afterward and at 8 selected intervals during the month which followed, random samples of two specimens were killed and assayed for viral infectivity. A standard sample of tissue which included the entire site of inoculation was excised, homogenized and diluted in serial 10-fold steps. Each dilution was inoculated into a separate group

of small bluegills which were held at 25° C for 20 days then scored for lymphocystis disease. A classical curve of virus multiplication was obtained. From the initial level, residual infectivity declined and disappeared in an eclipse phase that occurred 4 days post-inoculation. Thereafter, there was a rapid rise in demonstrable virus and exponential growth leveled off at 12 days post-inoculation. The level of infectivity remained high through the 30th day, when the experiment was terminated. These findings are correlated with the appearance of the lesions and with histological changes observed in previous work among bluegills under the same experimental conditions. (Authors)

10160. Jensen, Mogens H. (The State Veterinary Serum Lab., Hangovej, Denmark). 1965. RESEARCH ON EGTVED VIRUS. In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N. Y. Acad. Sci., 126(Art. 1): 422-426.

A review is given of findings by other investigators which indicate a virus to be the etiologic agent of Egtved disease (syn. INuL, Viral Haemorrhagic Septicaemia) of rainbow trout. Also, this work reports the application of monolayer cell culture techniques in virology of fish. The author's earliest experiments indicated that the virus, which has been called Egtved virus, could be propagated in primary ovarian cell cultures prepared from immature rainbow trout. These findings have been confirmed by recent work, which has also shown that the RTG-2 cell line, established by Wolf and Quimby, to be very useful for propagation of this virus. The technique used in isolation of the virus from fish and the typical cytopathic changes which occur in infected cultures are described. Egtved virus, in the form of infected tissue culture fluid, is found to be very labile at room temperature, but easily preserved at -20° C for at least 6 months. It is inactivated by 50% glycerol and by ether. Egtved virus has been passed more than 20 times in primary ovarian cell cultures, but seems to lose its pathogenity for rainbow trout after about 10 passages. (Auth.)

10161. Rasmussen, C. J. (The Danish Trout Pond Farm Experimental Station, Brønns, Denmark). 1965. A BIOLOGICAL STUDY OF THE EGTVED DISEASE (INuL). In: Proc. of Conf. on Viral Diseases of Poikilothermic Vertebrates. Ann. N. Y. Acad. Sci., 126(Art. 1): 427-460.

In Denmark during 1949-50, a previously unknown disease was found in rainbow trout in hatcheries in the eastern part of Jutland. It was named Egtved Disease after the locality where first found. The most characteristic symptoms are dropsy, exophthalmus, anemia, edema in muscles and various organs, degeneration of the liver and swelling of the kidneys. Hemorrhages are common in air-bladder, kidneys, muscles, sexual organs and intestinal fat. The outbreaks are most frequent during the winter and early spring and less common during the summer. All sizes of rainbow trout are affected, and the mortality may be very high especially in fry and fingerlings. Schäperclaus, who had earlier found and described the disease in Germany, named it "Infektiöse Nierenschwellung und Leberdegeneration (INuL)". Schäperclaus considered it to be a virus disease. The disease has been reported from the greater part of the European continent, and later authors have considered various nutritional deficiencies, especially lack of vitamins (vitamin B_1, B_{12}, and E), to be the primary cause of the disease. The research work of late years, however, has clearly shown a virus to be the prime cause. For the past 10 years research work at the Danish Trout Pond Farm Experimental Station has been directed towards clarifying of the disease. In recent years investigations were made in collaboration with The State Veterinary Serum Laboratory. The most important investigations were: (1) testing the various theories of nutritional deficiency; (2) investigations concerning incubation period of artificial and natural infections. (Liver filtrate from affected fishes has been used for artificial infection); (3) the influence of various foodstuffs and vitamins on outbreaks of the disease and upon mortality resulting from the disease; (4) the effect of antibiotics; (5) investigations concerning the ways in which the infection can be spread; (6) relationships with temperature; (7) immunologic investigations; and (8) investigations concerning artificial and natural infection of other salmonid species (Salvelinus fontinalis, Salmo trutta, Salmo salar) and their importance as carriers of infection. (Auth.)

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